STOPPING WATER POLLUTION AT ITS SOURCE

MISA

Municipal/Industrial Strategy for Abatement

PRELIMINARY REPORT

ST. CLAIR RIVER MISA PILOT-SITE INVESTIGATION

VOLUME I: PART I

NOVEMBER 1987

Ontario

Ministry of the Environment

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Minister

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Deputy Minister

PRELIMINARY REPORT
ST. CLAIR RIVER MISA
PILOT-SITE INVESTIGATION
VOLUME I: PART I

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FOREWORD

The preliminary report - St. Clair River MISA Pilot-Site Investigation (Volume I) includes preliminary assessment of data collected primarily from the Dow Chemical site during 1986.

Staff are currently editing the data and collecting supportive information to prepare a final report (Volume II) by October, 1988.

Part I of Volume I deals with results of four major components of the investigation:

1. Sequential Sampling
2. Effluent Monitoring
3. Ecosystem Monitoring
4. Investigative Sampling

Sequential Sampling: Designed to address the effects of discharges from Dow Chemical, the Cole Drain and the Polysar 72" sewer on the aquatic environment in the vicinity of the Ontario shoreline. This sequential sampling entailed the collection of effluent and ambient samples at half-hour intervals. Data generated from the sequential sampling are being used to calibrate and validate chemical dispersion and fate models.

Effluent Monitoring: Sampling of the Cole Drain, the Polysar Biox Unit, and the Polysar 72" sewer; the Dow 42, 48, 54" sewers (1st St. complex) and the Dow 2nd, 3rd and St. sewers, took place on a 2x/week basis. This sampling component concluded in May 1987.

Data generated by this effluent monitoring will provide insight into loadings of organics discharged to the St. Clair River. These data will also facilitate interpretation of information collected at the "ecosystem monitoring" stations.

Ecosystem Monitoring: The understanding of the behaviour of contaminants in different biota compartments should lead to a successful application of fate and transport models. Body burden analysis were carried out for benthos and sculpins, spottail shiners, cladophora, clams, macrophytes and phytoplankton. An attempt was also made to estimate total biomass. Effluent toxicity and mutagenicity tests were also carried out.

Investigative Sampling: This component was aimed at determining the concentration of trace organics at the sediment-water interface. Forty-three stations were sampled from the river headwaters to the St. Clair Delta.

Part II of Volume I (Appendices 1 to 6) contains data generated for a number of investigative components at ambient and effluent sampling locations.

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ST. CLAIR RIVER AT SARNIA MISA PILOT-SITE INVESTIGATIONS

All field components for the St. Clair River MISA pilot-site investigation have been completed. A brief overview of the major findings from preliminary assessment of 1986 MISA data is provided on a component by component basis.

SUMMARY AND FINDINGS

Loadings calculated from the twice weekly as well as sequential effluent sampling components indicate that the 42" sewer (1st St. sewer complex) is a major source of both volatile and higher chlorinated hydrocarbon compounds. A comparison with 1985 data indicates reductions on the order of 83% for total volatile loadings and 81.5% for higher chlorinated hydrocarbons associated with the Dow complex.

Loadings of volatile compounds were reduced by 97.7% at the 3rd St. sewer, 95% at the 2nd St. sewer, 67% at the 54" sluice and 61.2% at the 4th St. sewer. Increases in loadings of total volatile compounds were observed at the 42 and 48 inch sewers which discharge from the 1st St. complex.

Loadings of higher chlorinated hydrocarbons were reduced at all outfalls and ranged from 65.8% at the 48 inch sewer to 97% at the 3rd St. sewer. Reductions from the Dow 42 inch sewer were on the order of 78%.

Peaks in discharges from various outfalls resulted in corresponding peaks both at stations immediately downstream of outfalls and at locations farther afield. Mathematical models are being applied to provide insight into cause-effect relationships.

- Loadings trends indicate increases for several parameters (Perc., HCBD, HCE) at the Dow 4th St. sewer since 1985. This is attributed to the diversion of the highly contaminated 30 inch acid tile sewer to the 4th St. outfall via a newly constructed settling pond. Increases in volatile loadings at the Dow 42 inch and 48 inch sewers during May 21, 1986 sequential sampling as compared to 1985, reflected an excursion of high volatile loadings. The long-term average based on twice weekly sampling was more consistent with the total volatile flux estimated from 1985 results.

- In general, levels monitored from the Dow 42" effluent were 1-2 orders of magnitude higher than other outfalls, with the exception of the Cole Drain. A comparison of loading trends for the period November, 1985 to September 1986 revealed reductions for most parameters during this interval were typically an order of magnitude. One exception to this occurred for octachlorostyrene where loadings did not appear to differ significantly.

- Investigative sampling of surface and bottom waters at 43 locations along the river revealed the presence of hexachloroethane (10-169 ng/L) hexachlorobutadiene (10-87 ng/L) hexachlorobenzene (10-75 ng/L) and octachlorostyrene (17-20 ng/L). These compounds were generally confined to localized areas adjacent to Polysar (Cole drain) and Dow Chemical.

  Volatile compounds, tetrachloroethylene (perchloroethylene - perc.) (1-44 ug/L), carbon tetrachloride (1-42 ug/L); 1,1-dichloroethane (1-14 ug/L); 1,2-dichloroethane (1-16 ug/L); 1,1,1-Trichloroethane (1-22 ug/L); 1,1,2-trichloroethane (1-4 ug/L) and trichloroethylene (1-2 ug/L) were detected during sampling in May 1986. Again, peaks were observed in nearfield areas adjacent to Dow Chemical and Polysar.

- Surficial sediment grabs revealed a trend of decreasing concentrations with increasing distances from shore for metals adjacent to the Dow 1st St. sewer complex. Cadmium, chromium, copper, mercury, magnesium and nickel were 2-9 times higher in the nearshore (10 m offshore) station vs. the station 30 m offshore.

  Comparison of mercury concentrations measured during the 1985 MOE/Environment Canada investigation are generally in agreement with the present study. Mercury levels of 28 ug/g were observed in surficial sediments adjacent to the Dow property during 1985. Corresponding MISA data reveal mercury in the range of 1 to 42 ug/g. Low, but consistent mercury losses ($\approx$ 5 gram/day loadings) have been measured from the Dow 54" sewer during 1986 twice weekly effluent sampling.

Bioassessment has involved a number of techniques and several vertebrate and invertebrate test organisms.

- Findings of 1986 juvenile fish collections revealed a continuing trend of decreasing tetrachloroethylene accumulations in emerald shiners following the Dow Chemical spill in August 1985. While octachlorostyrene and hexachlorobenzene residues in the 1985 collections have declined considerably from 1983 levels, concentrations at Suncor and the Lambton Generating Station are still much elevated when compared to Great Lakes' background.

- Mutagenicity testing by MOE has revealed no positive response for water samples analyzed thus far. As a result, further testing is not anticipated, unless chemical effluent characterization indicates a need. This would be based on the presence of mutagenic compounds in effluent.

- Contaminant results in juvenile fish and sport fish are pending. Limited volatiles data has been received thus far; however, further data has yet to be received.

- Results of samples of contaminated sediment and associated biota (benthic, sculpin and sediment chemical results) have been completed; however, these require assessment and interpretation. Results of the benthic enumeration study have also been received but these have not yet been interpreted.

- Sediment bioassays in January 1987 were conducted using fathead minnows and mayflies. Mortality was low at all stations with the exception of two stations below the 1st St. outfalls. Significant mortality was observed for mayflies and for fathead minnows, but to a lesser extent. Tissue analysis for surviving test organisms are pending.

- Additional investigative components, in particular bio-monitoring or "ecosystem sampling" have limited data available at this time and are inconclusive at this juncture. It is anticipated that these results will assist interpretation of ambient and effluent data and answer questions regarding the impact on biota.

RIVIÈRE ST. CLAIR - ANALYSES EFFECTUÉES À SARNIA

(SITE PILOTE DE LA SMID)

Toutes les analyses effectuées à cet emplacement pilote sont terminées. Les principaux résultats de l'évaluation préliminaire des données de 1986 sont présentés brièvement, élément par élément.

LES RÉSULTATS EN BREF

D'après les calculs ayant suivi les prélèvements bihebdomadaires et séquentiels effectués sur les effluents, on constate que l'égout de 42 po (complexe de la 1re Rue) contient d'importantes charges de composés d'hydrocarbures volatiles et de composés très chlorés. Par rapport aux résultats de 1985, on enregistre une diminution de l'ordre de 83 p. 100 des charges d'hydrocarbures volatiles totaux, et de 81,5 p. 100 pour ce qui est des hydrocarbures fortement chlorés provenant du complexe Dow.

Les charges des composés volatiles ont diminué de 97,7 p. 100 à l'égout de la 3e Rue, de 95 p. 100 à celui de la 2e Rue, de 67 p. 100 au canal de 54 po, et de 61,2 p. 100 à l'égout de la 4e Rue. On a par contre enregistré une augmentation de la quantité totale de composés volatiles aux égouts de 42 et de 48 po par lesquels sont déversées les eaux du complexe de la 1re Rue.

Les concentrations d'hydrocarbures fortement chlorés ont diminué à tous les exutoires et leur réduction a varié d'une valeur de 65,8 p. 100 à l'égout de 48 po à une valeur de 97 p. 100 à l'égout de la 3e Rue. À l'égout de 42 po de la société Dow, elle a été d'environ 78 p. 100.

Les déversements de pointe enregistrés aux divers exutoires ont entraîné des concentrations correspondantes tant aux stations situées immédiatement en aval des exutoires qu'aux stations

plus éloignées. Pour mieux comprendre les relations de cause à effet, on applique des modèles mathématiques.

. Les analyses effectuées révèlent une augmentation de la concentration de certains produits (perc., HCBD, HCE) à l'égout de Dow situé à la 4e Rue, par rapport à 1985. Cela est dû au détournement de l'égout de 30 po, destiné à l'évacuation d'eaux fortement polluées, vers l'exutoire de la 4e Rue via un nouvel étang de décantation. L'augmentation, par rapport à 1985, des concentrations de produits volatiles aux égouts de 42 et de 48 po de Dow, ainsi qu'on l'a constaté au cours de l'échantillonnage séquentiel du 21 mai 1986, indique qu'une grande quantité de produits volatiles ont emprunté une voie différente de la normale. La moyenne obtenue au terme de nombreux prélèvements bihebdomadaires est apparue plus conforme à l'estimation de l'ensemble des matières volatiles découlant des résultats de 1985.

. En général, les concentrations enregistrées à l'exutoire de 42 po de Dow étaient de 10 à 20 fois plus élevées qu'aux autres exutoires, à l'exception de la conduite de Cole. Après comparaison des concentrations enregistrées entre novembre 1985 et septembre 1986, on a constaté une forte diminution (d'environ 10 fois) de la plupart des paramètres pendant cette période. Seule exception, les concentrations d'octachlorostyrène, qui n'ont pas varié sensiblement.

. L'analyse d'échantillons prélevés à la surface et au fond des eaux à 43 points différents de la rivière a révélé la présence d'hexachloroéthane (10 à 169 ng/L), d'hexachlorobutadiène (de 10 à 87 ng/L), d'hexachlorobenzène (de 10 à 75 ng/L), et d'octachlorostyrène (de 17 à 20 ng/L). Ces composés se trouvaient généralement concentrés en des endroits précis proches des sociétés Polysar (conduite de Cole) de Dow Chemical.

- v a -

Au cours de l'échantillonnage de mai 1986, on a détecté les composés volatiles suivants : tétrachloroéthylène (perchloroéthylène, ou perc.) (de 1 à 44 ug/L), tétrachlorure de carbone (de 1 à 42 ug/L), 1,1-dichloroéthane (de 1 à 14 ug/L), 1,2-dichloroéthane (de 1 à 16 ug/L), 1,1,1-trichloroéthane (de 1 à 22 ug/L), 1,1,2-trichloroéthane (de 1 à 4 ug/L) et trichloroéthylène (de 1 à 2 ug/L). Là encore, les plus fortes concentrations ont été enregistrées à proximité des sociétés Dow Chemical et Polysar.

. Les prélèvements de sédiments superficiels ont montré que les concentrations tendent à diminuer à mesure qu'on s'éloigne de la rive, pour ce qui est des métaux trouvés près des égouts de Dow situés à la 1re Rue. Les concentrations de cadmium, de chrome, de cuivre, de mercure, de magnésium et de nickel étaient entre deux et neuf fois supérieures près de la rive (à une distance de 10 mètres) à celles de la station située à 30 mètres de la rive.

En ce qui concerne les concentrations de mercure, les résultats de la présente étude confirment généralement ceux des analyses effectuées par Environnement Canada en 1985. On a enregistré des concentrations de 28 ug/g dans les sédiments superficiels se trouvant près du complexe Dow en 1985. Les données obtenues dans le cadre de la SMID révèlent des concentrations variant de 1 à 42 ug/g. Les prélèvements bihebdomadaires effectués à la sortie de l'égout de 54 po de Dow en 1986 ont révélé la présence de concentrations de mercure faibles, mais constantes (environ 5 g par jour).

Les évaluations biologiques ont nécessité l'emploi d'un certain nombre de techniques et ont porté sur plusieurs organismes vertébrés et invertébrés.

- Chez les jeunes poissons étudiés en 1986, on a constaté, après l'accident survenu à la société Dow Chemical en août 1985, une diminution régulière des accumulations de tétrachloroéthylène dans l'organisme des ménés émeraudes. Si les concentrations d'octachlorostyrène et d'hexachlorobenzène ont diminué très sensiblement entre 1983 et 1985, les concentrations enregistrées au complexe Suncor et à la centrale électrique de Lambton sont encore beaucoup trop élevées par rapport aux concentrations enregistrées dans les Grands Lacs.

- Les échantillons d'eau analysés jusqu'à présent par le MDE n'ont révélé la présence d'aucune mutation. Il n'est donc pas prévu de poursuivre ces examens, sauf s'ils sont rendus nécessaires par la composition chimique des effluents. Il faudrait pour cela que ces derniers contiennent des composés mutagènes.

- On connaîtra bientôt les effets des polluants sur les jeunes poissons et sur les poissons que l'on pêche. On ne possède pour l'instant que des renseignements limités sur les matières volatiles; on attend des renseignements complémentaires.

- On connaît désormais les résultats des prélèvements effectués sur les sédiments contaminés et le biote correspondant (analyse chimique du benthos, des chabots et des sédiments); il reste, par contre, à analyser et à interpréter ces résultats. On dispose également des résultats de l'étude concernant le recensement des organismes benthiques, mais ils n'ont pas encore été interprétés.

. Pour les essais biologiques effectués en janvier 1987 sur les sédiments, on s'est servi de ménés à tête plate et d'éphémères. On a enregistré un faible taux de mortalité à toutes les stations, à l'exception de deux stations situées en aval des exutoires de la 1re Rue. On a enregistré un taux de mortalité sensible chez les éphémères mais moindre chez les ménés à tête plate. On attend les résultats des analyses réalisées sur les tissus des organismes survivants.

. Pour ce qui est des autres examens effectués, en particulier la surveillance biologique ou les "échantillonnages écosystémiques", on ne possède que des renseignements limités dont on ne peut encore tirer aucune conclusion. On espère que ces résultats permettront d'interpréter plus facilement les données concernant le milieu aquatique et les effluents et de répondre aux questions relatives aux effets des polluants sur le biote.

ST. CLAIR RIVER MISA PILOT SITE INVESTIGATIVE COMPONENTS

SEQUENTIAL SAMPLING:

Introduction and Purpose:

Sequential sampling is aimed at addressing nearfield contaminant distribution and verifying fate and transport models. Frequent sampling for a short duration at a number of effluent and ambient locations enabled a snapshot of impact on receiving water to be viewed.

Methods:

Sequential sampling was carried out on 3 separate occasions during 1986. These dates are as follows: May 21st, July 8th and October 1st. Locations identified on figures 1 and 2 were sampled every half-hour for a seven hour period.

Staff from the London Regional Office, Sarnia District Office and Great Lakes Section cooperated in the joint effort. Individuals were stationed at each shore location, thus allowing sampling to occur simultaneously. Two vessels (Nekton-SW Region; Guardian I-GLS) were responsible for river sampling at the seven river stations. The Nekton obtained samples from 1m subsurface at stations 215 and 204 and a depth composite from station 203. Guardian I obtained subsurface grabs from the remaining stations.

A refrigerated vehicle was used to hold and transport samples throughout the day and for transport to the Rexdale Laboratory.

FIGURE 1:

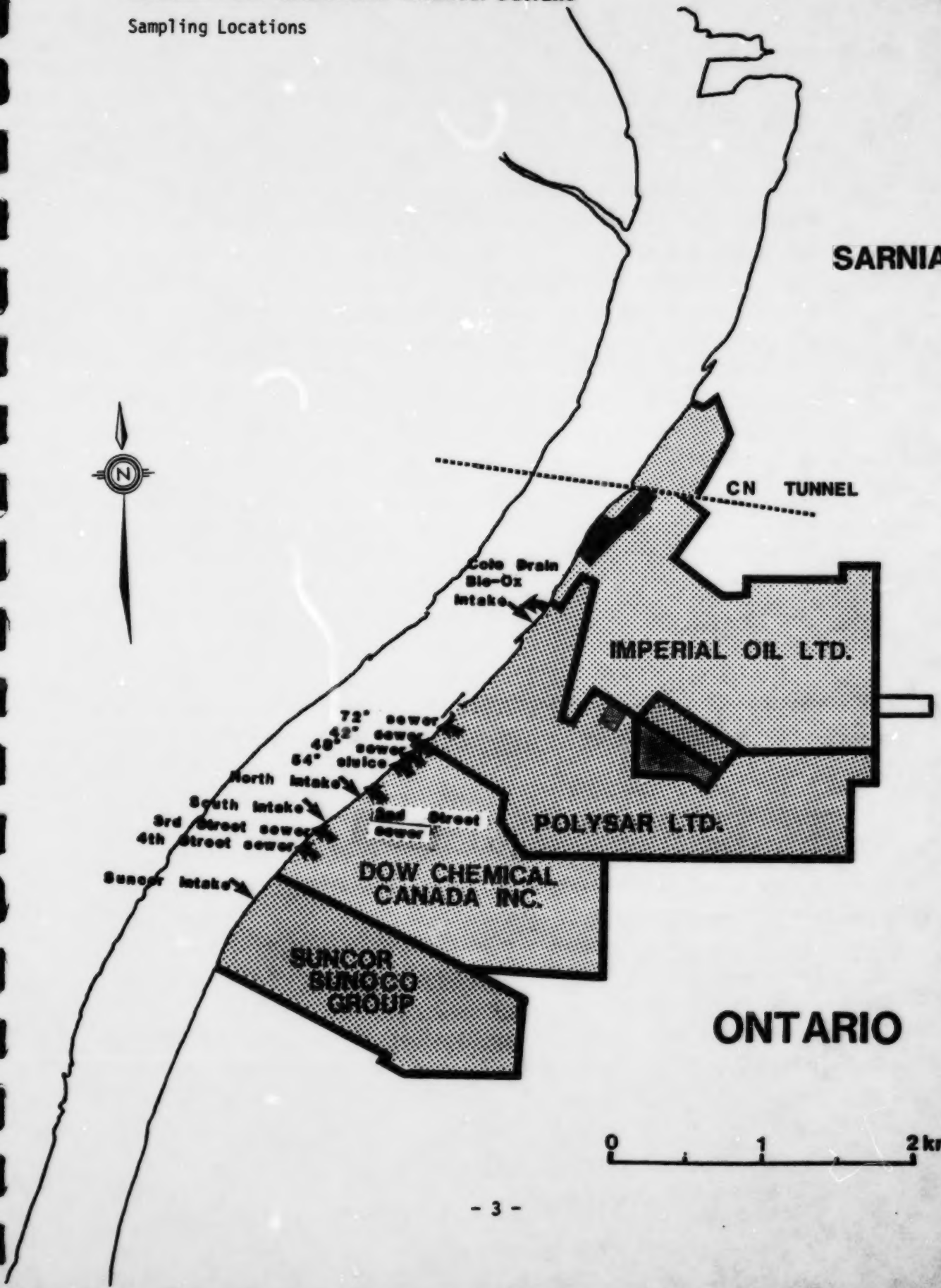
SEQUENTIAL SAMPLING—Ambient

Sampling Locations

FIGURE 2:

SEQUENTIAL SAMPLING—Intakes/Outfalls

Sampling Locations



Results and Discussion:

Raw data for selected parameters (selection based on predominance of results above detection limits) from ambient and effluent samples respectively are presented in Appendix 2.

Loadings calculated for the May 21st sequential sampling (based on 14 measurements) indicated the greatest losses to the St. Clair River occurred at the 42" sewer (1st St. sewer complex) for both volatiles and higher chlorinated hydrocarbons (Table 1). A comparison with 1985 data indicates reductions on the order of 83% for total volatile loadings associated with the Dow complex, from approximately 360 kg/day during 1985 to 62.2 kg/day in May 1986. Loading reductions of 97.7% were observed at the 3rd St. sewer while reductions ranged from 61.2% at the 4th St. sewer to 96% at the 2nd St. outfall. Increases of 103 - 151% were observed at the 42 and 48 inch sewers which discharge from the 1st St. complex.

Overall loadings of higher chlorinated hydrocarbons were similarly reduced 81.5% from 1985 to May 1986. Chlorinated hydrocarbon loading reductions ranged from 65.8% at the 48 inch sewer to 97% at the 3rd St. sewer. Reductions from the Dow 42" sewer were on the order of 78%.

Measured ambient values indicated a positive correlation between contaminants, particularly carbon tetrachloride and perchloroethylene (tetrachloroethylene). Positive correlations were also noted for hexachlorobutadience (HCBD), hexachlorobenzene (HCB) and hexachloroethane (HCE) indicating the possibility of a common source. A negative correlation was observed between contaminant levels and distance from shore (Table 2), indicating a reduction in contaminants with increasing distance from shore.

The response of river water quality to peaks in discharges from various outfalls is illustrated in figures 3-10. Periodic elevations in contaminants resulted in corresponding peaks both at stations immediately downstream of outfalls and at locations farther afield.

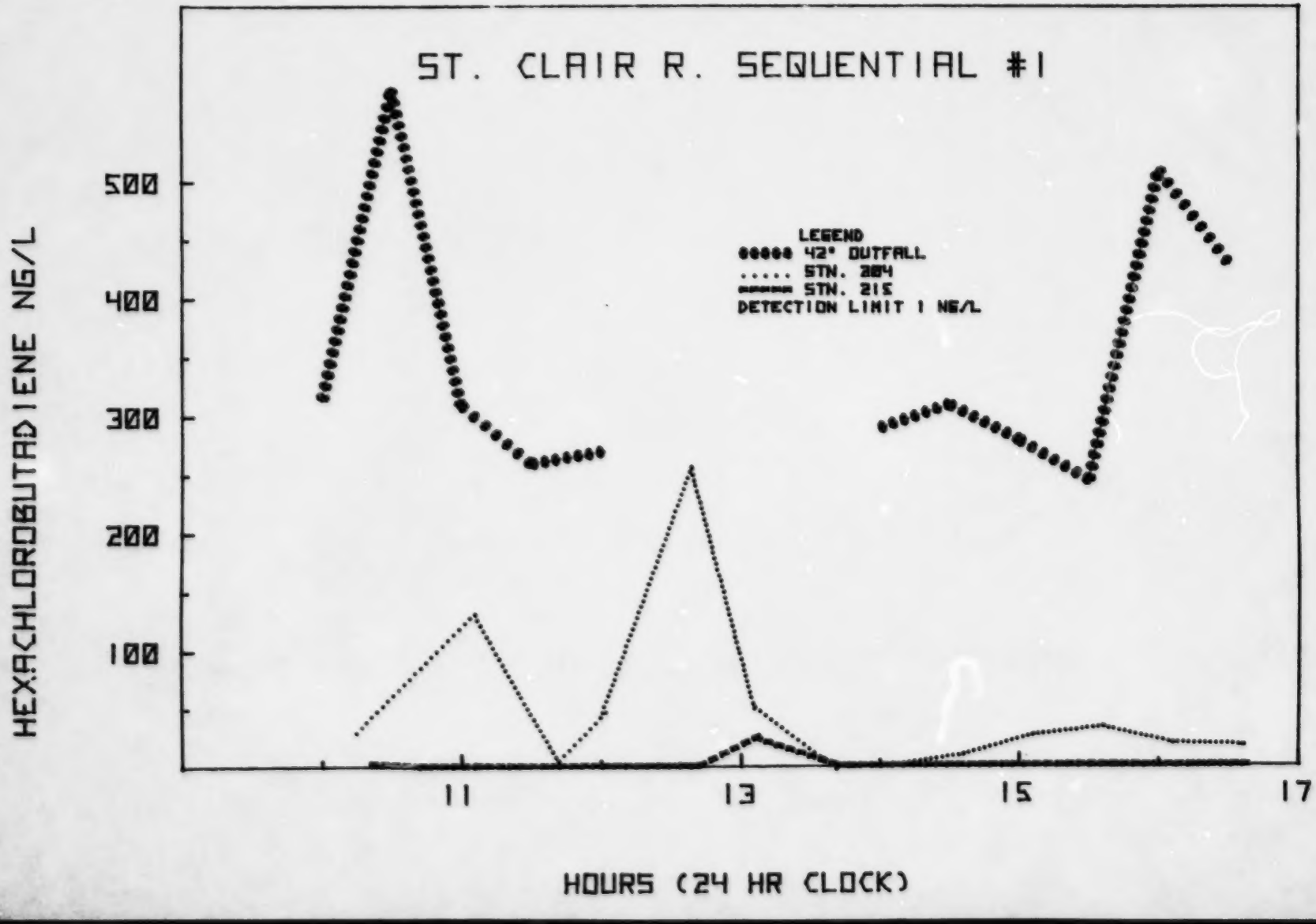

ST. CLAIR R. SEQUENTIAL #1
HEXACHLOROBUTADIENE NG/L
500
400
300
200
100
LEGEND
42° OUTFALL
STN. 284
STN. 215
DETECTION LIMIT 1 NG/L
11
13
15
17
HOURS (24 HR CLOCK)

FIGURE 3:

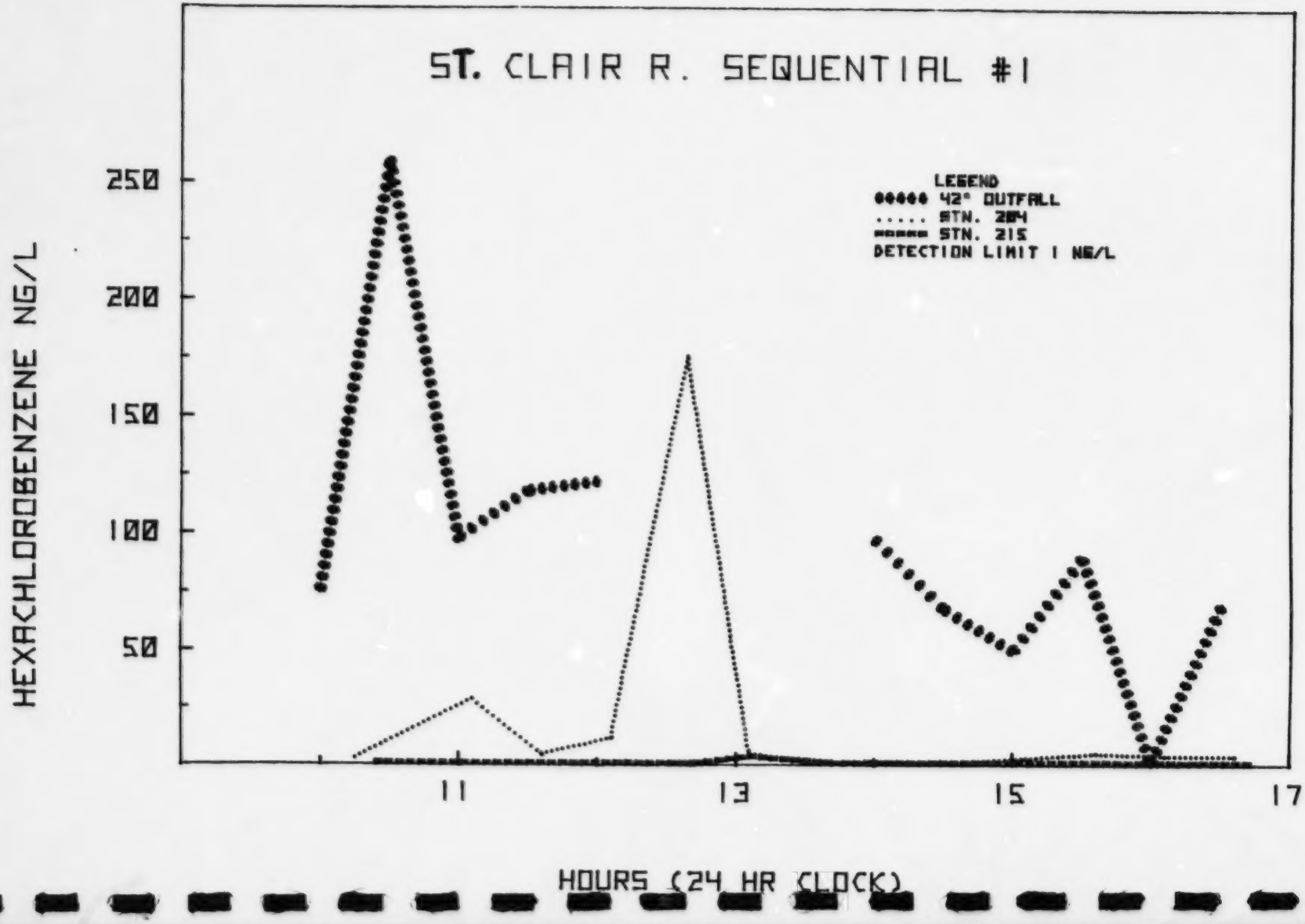

ST. CLAIR R. SEQUENTIAL #1
LEGEND
42° OUTFALL
STN. 204
STN. 215
DETECTION LIMIT 1 NG/L
HEXACHLOROBENZENE NG/L
250
200
150
100
50
11
13
15
17
HOURS (24 HR CLOCK)

FIGURE 4:

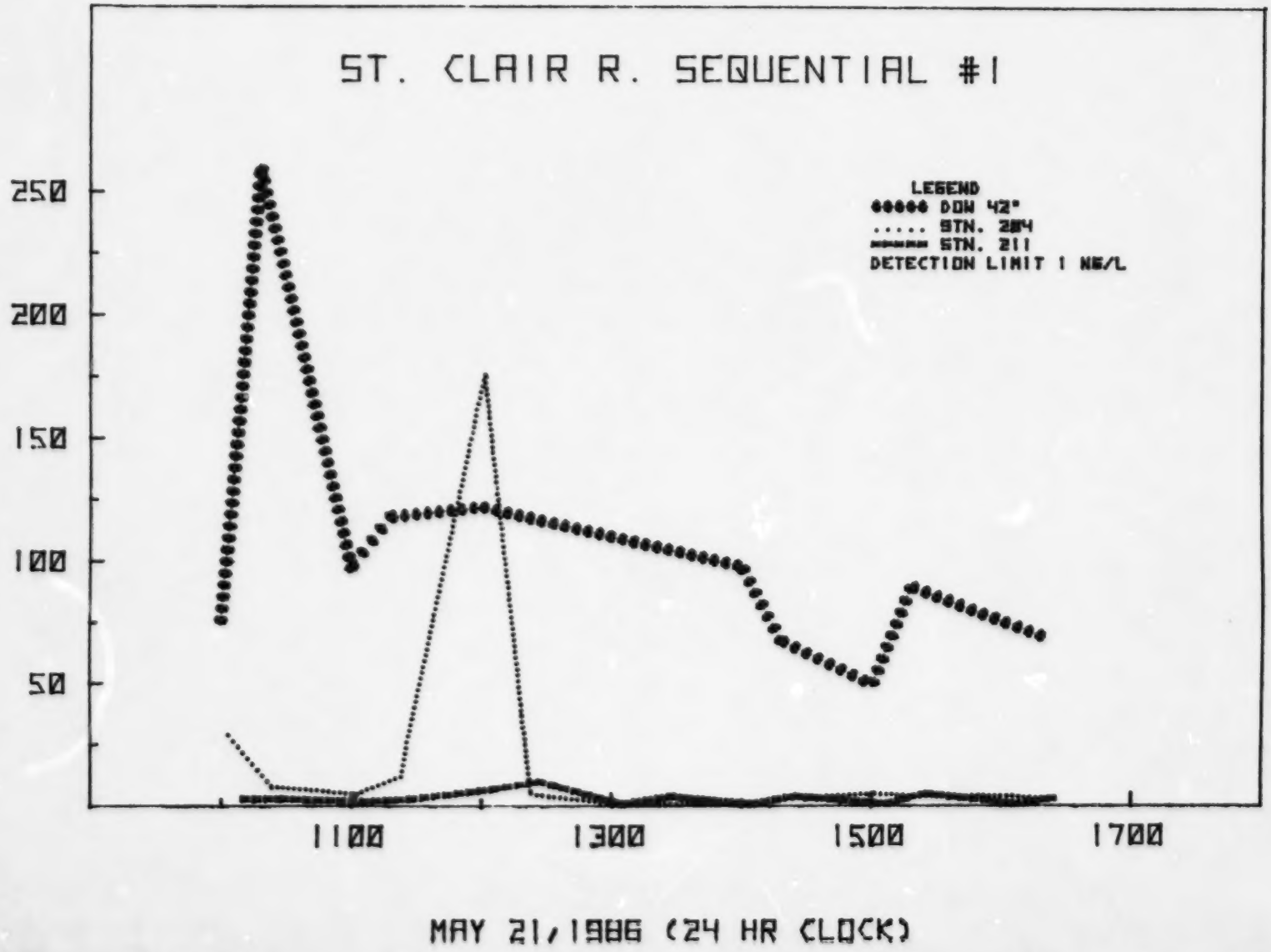

ST. CLAIR R. SEQUENTIAL #1
LEGEND
DOW 42*
STN. 284
STN. 211
DETECTION LIMIT 1 NG/L
250
200
150
100
50
1100
1300
1500
1700
HCB NG/L
MAY 21, 1986 (24 HR CLOCK)

FIGURE 5:

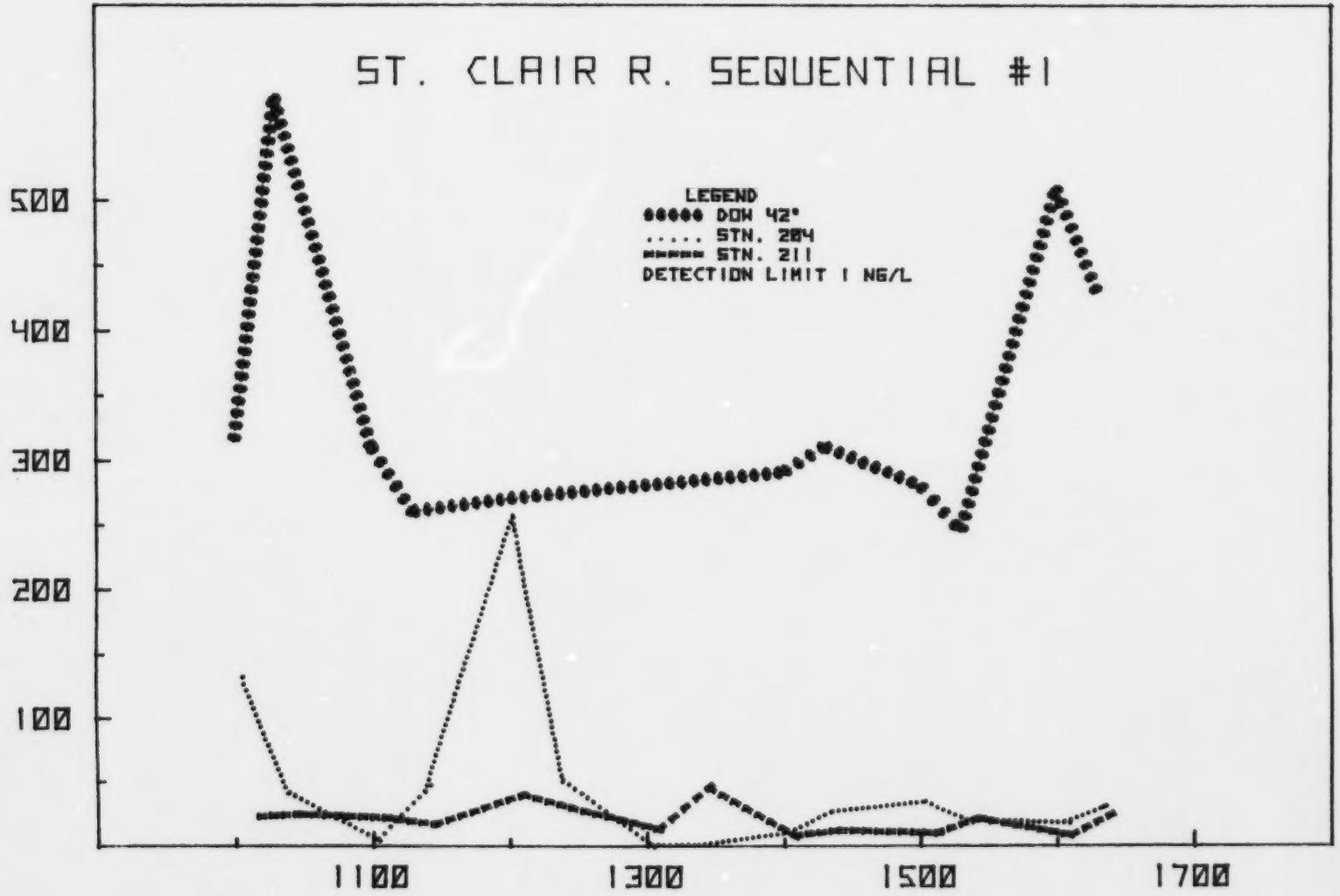

ST. CLAIR R. SEQUENTIAL #1
LEGEND
DOW 42°
STN. 204
STN. 211
DETECTION LIMIT 1 NG/L
500
400
300
200
100
HCBD NG/L
1100
1300
1500
1700
MAY 21, 1986 (24 HR CLOCK)

FIGURE 6:

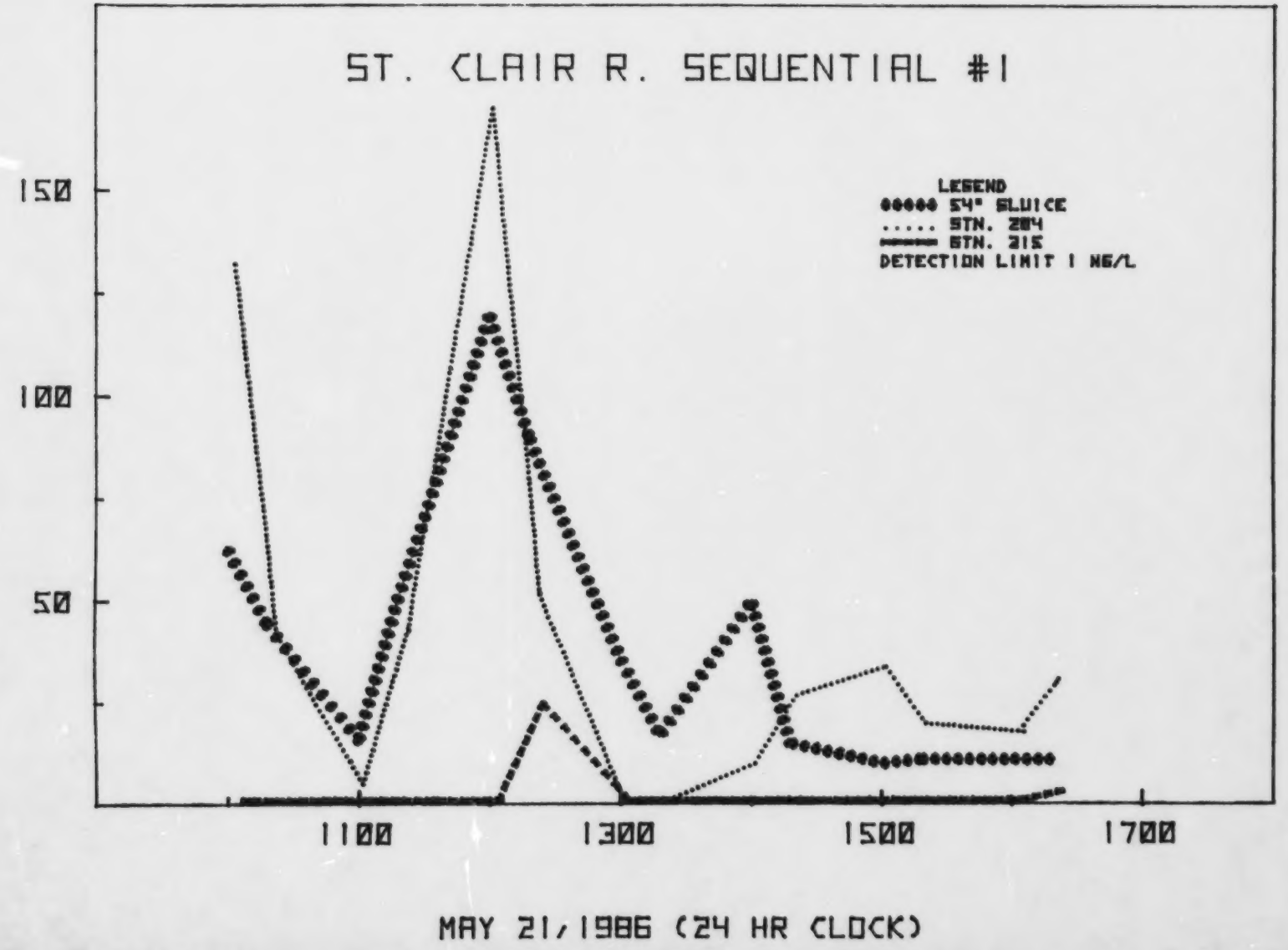

ST. CLAIR R. SEQUENTIAL #1
LEGEND
54° SLUICE
STN. 284
STN. 215
DETECTION LIMIT 1 NG/L
150
100
50
HCBD NG/L
1100
1300
1500
1700
MAY 21, 1986 (24 HR CLOCK)

FIGURE 7:

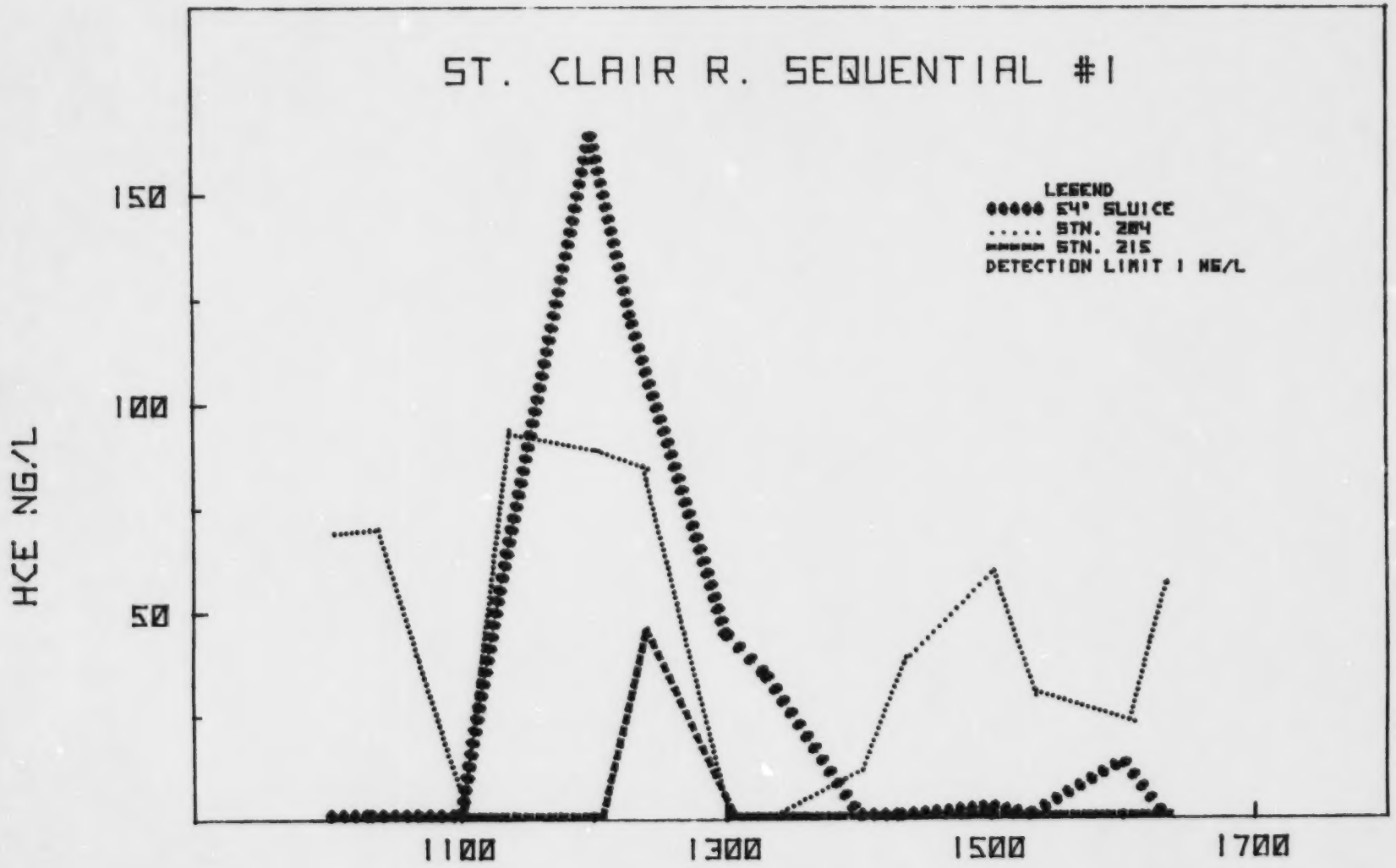

ST. CLAIR R. SEQUENTIAL #1
LEGEND
54" SLUICE
STN. 284
STN. 215
DETECTION LIMIT 1 NG/L
150
100
50
HCE NG/L
1100
1300
1500
1700
MAY 21, 1986 (24 HR CLOCK)

FIGURE 8:

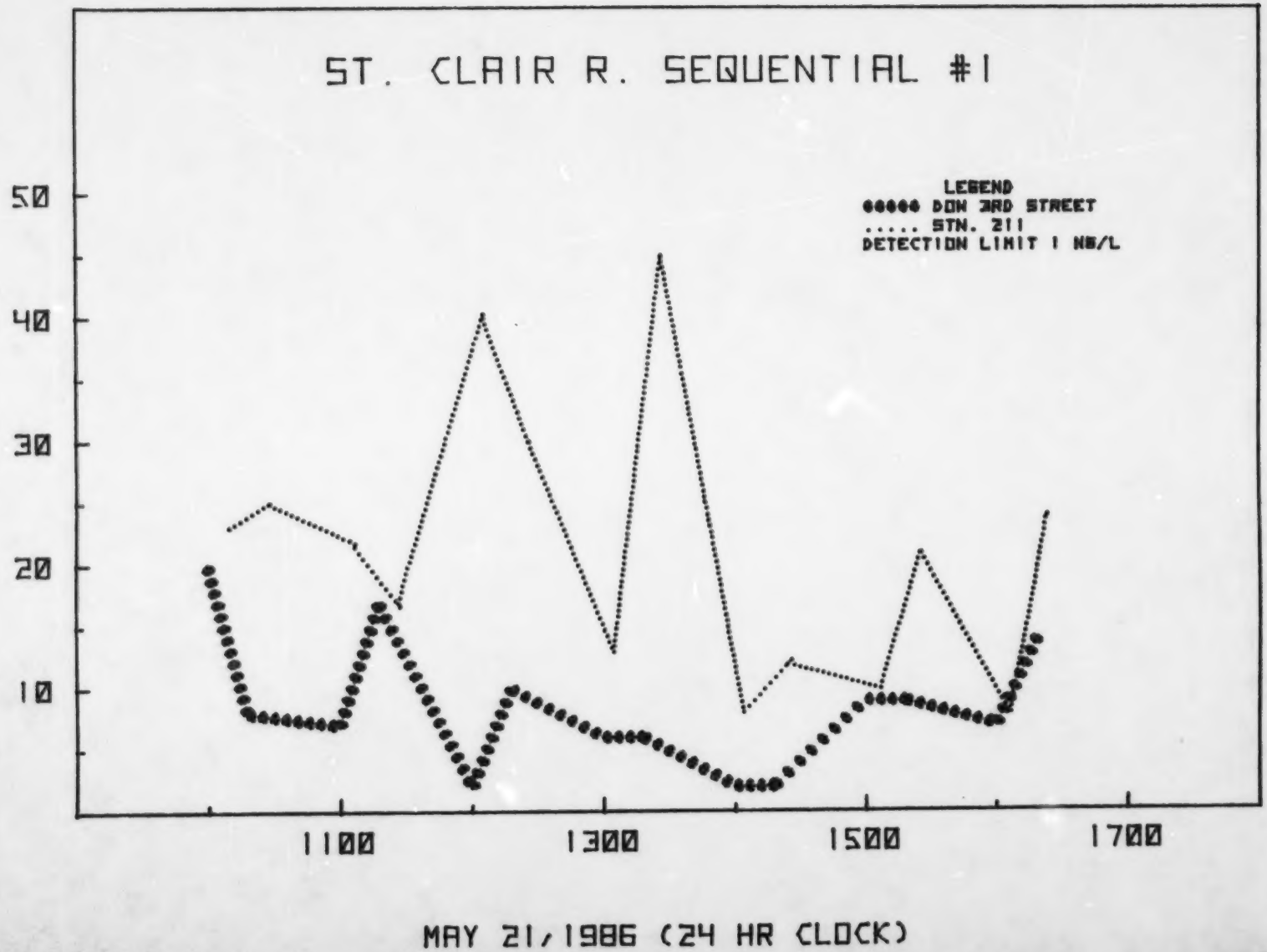

ST. CLAIR R. SEQUENTIAL #1
LEGEND
DON 3RD STREET
STN. 211
DETECTION LIMIT 1 NG/L
50
40
30
20
10
1100
1300
1500
1700
MAY 21, 1986 (24 HR CLOCK)
4CBD NG/L

FIGURE 9:

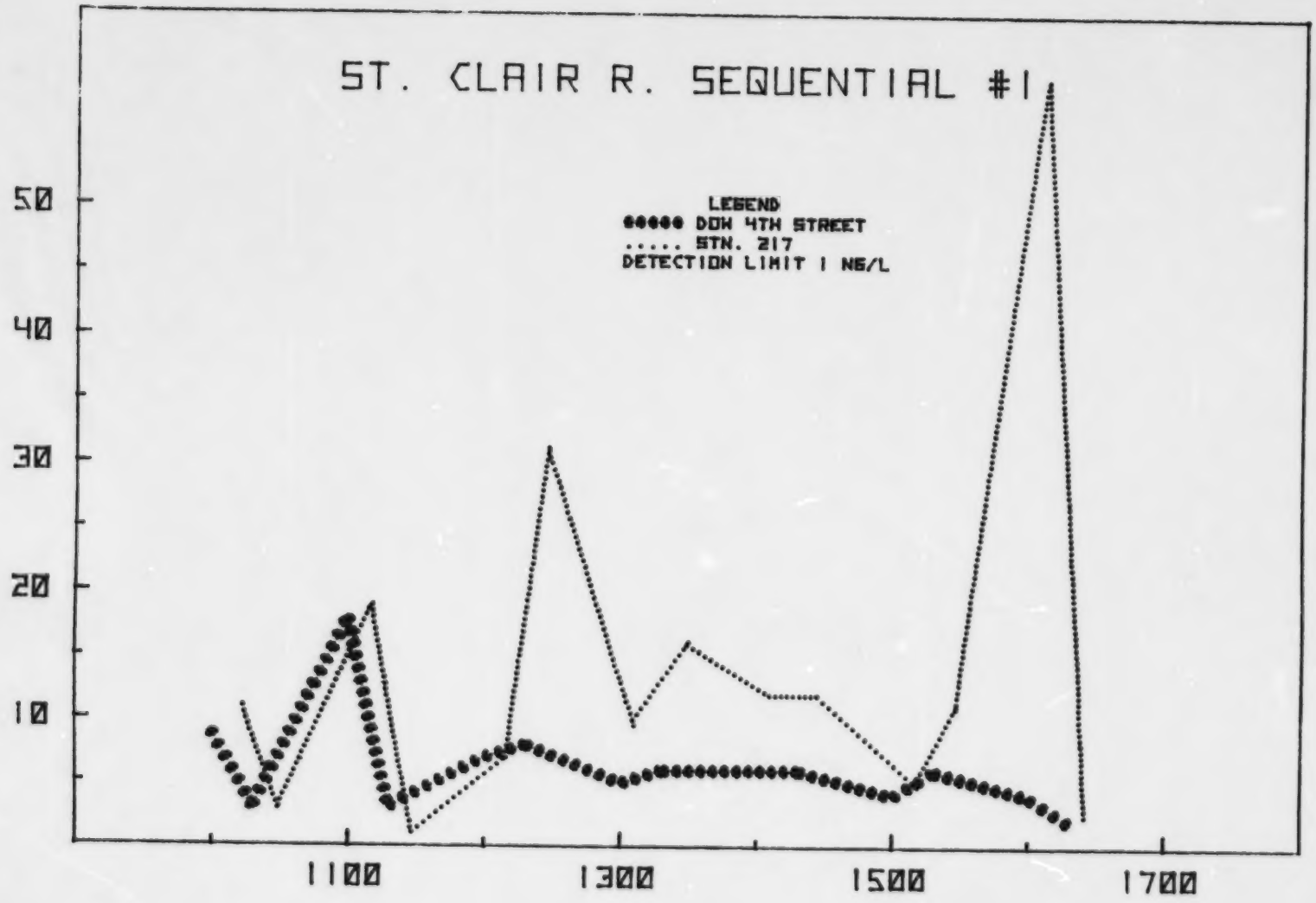

ST. CLAIR R. SEQUENTIAL #1
LEGEND
DOW 4TH STREET
STN. 217
DETECTION LIMIT 1 NG/L
50
40
30
20
10
1100
1300
1500
1700
HCBD NG/L
MAY 21, 1986 (24 HR CLOCK)

FIGURE 10:

Figure 10 illustrates a closely parallel response between Dow's 4th St. discharge and Stn. 217 for HCBD, between 1030 and 1130. Peaks noted at Stn. 217 later in the day were not attributed to 4th St. effluent but to the 42" sewer discharges. Mathematical models are being applied to provide insight into cause-effect relationships.

A rapid decline in ambient concentrations was observed between stations 204 and 215 (30 and 100m from Canadian shore, respectively), adjacent to the Dow 1st St. sewer complex (Figures 3-4). Contaminants measured at station 215 were generally 1 to 2 orders of magnitude lower in concentration.

At station 18, located at the southern Suncor boundary, a more uniform distribution of contaminants was evident, as levels nearshore were similar or only slightly higher than those offshore. A summary of mean concentrations (n = 14) appears below. Wide standard deviation ranges are the result of a patchy source with a number of observed peaks.

Station	Distance from Cdn. shore (m)	HCBD ng/L	HCB ng/L	HCE ng/L
204	30	48.3 ± 68.1	19.1 ± 45.6	43.4 ± 32.9
215	100	2.9 ± 6.2	1.2 ± 0.8	4.21 ± 11.6
18	30	9.3 ± 4.2	1.1 ± 0.4	8.0 ± 4.1
18	100	5.6 ± 3.1	1.1 ±1 0.3	5.4 ± 5.0

Estimation of Loadings:

For purposes of loading estimations for this and other components, the following average flow values were utilized based on values provided by Polysar and Dow:

Outfall	Average Flow $x10^3$ m^3/day
Polysar 72"	27.5
Cole Drain	70.0
Dow 42"	58.7
Dow 48"	64.5
Dow 54"	31.0
Dow 2nd St.	57.2
Dow 3rd St.	79.0
Dow 4th St.	400.4

TABLE 1: Loadings of compounds entering the St. Clair River from Dow Chemical sewers: 1985/1986

LOADINGS (kg/day)	1985 1st St. 42"	1986 1st St. 42"	1985 1st St. 48"	1986 1st St. 48"	1985 1st St. 30"	1985 1st St. 54"	1986 1st St. 54"	1985 2nd St.	1986 2nd St.	1985 3rd St.	1986 3rd St.	1985 4th St.	1986 4th St.
CHLORINATED AROMATICS:													
1,2,3,4-Tetrachlorobenzene	0.0017	-	-	-	0.0006	-	-	0.0003	-	0.0003	-	-	-
1,2,3,5-Tetrachlorobenzene	0.0007	-	-	-	0.0003	-	-	0.0003	-	0.0003	-	-	-
1,1,2-Trichlorobenzene	0.0005	-	-	-	-	-	-	-	-	0.0007	-	-	-
1,2,4,5-Tetrachlorobenzene	-	-	-	-	0.0002	-	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	0.3840	0.0036	0.0011	-	0.0430	0.0027	0.0001	0.0055	0.0008	0.0023	-	0.0120	-
1,2-Dichlorobenzene	0.0030	-	-	-	0.0004	-	-	-	-	0.0360	-	-	-
1,3,5-Trichlorobenzene	0.0072	-	-	-	0.0027	-	-	0.0005	-	0.0004	-	-	-
1,3-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	0.0338	-	-	-	0.0047	-	-	-	-	-	-	-	-
2,3,6-Trichlorotoluene	NM	-	NM	-	NM	NM	-	NM	-	NM	-	NM	-
2,4,5-Trichlorotoluene	NM	0.1280	NM	0.0002	NM	NM	0.0004	NM	-	NM	0.0003	NM	0.0013
2,6-a-Trichlorotoluene	NM	-	NM	-	NM	NM	-	NM	-	NM	-	NM	-
alpha-Benzene Hexachloride	0.0005	-	0.0002	-	-	0.0001	-	0.0002	-	0.0007	-	0.0015	-
gamma-Chlordane	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.0091	0.0056	0.0010	0.0003	0.0280	0.0006	-	0.0003	0.0002	0.0011	0.0002	0.0029	0.0014
Hexachlorobutadiene	0.1885	0.0203	0.0009	0.0007	0.0190	0.0018	0.0012	0.0012	0.0009	0.0019	0.0007	0.0026	0.0025
Hexachloroethane	0.1300	0.0083	0.0005	0.0001	0.0280	0.0216	0.0010	0.0011	0.0005	0.0016	0.0001	0.0035	0.0012
Linsanl	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene	0.0027	0.0048	0.0001	-	0.0016	0.0001	-	-	0.0001	0.0001	0.0002	0.0002	-
Pentachlorobenzene	0.0030	0.0002	-	-	0.0010	-	-	-	-	0.0007	-	0.0001	-
p,p'-DDD	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p'-DDE	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p'-DDT	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PCB's	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL LOADINGS	0.7647	0.1708	0.0038	0.0013	0.1295	0.0269	0.0027	0.0094	0.0025	0.0461	0.0015	0.0228	0.0064

1985 Total: 1.00 kg/day (source: Jan. 1986 MOE/DOE Pollution Investigation)
1986 Total: 0.185 kg/day (source: May 21, 1986 MISA Sequential Sampling)
NM - not measured
- not detected

LOADINGS (kg/day)	1985 1st St. 42"	1986 1st St. 42"	1985 1st St. 48"	1986 1st St. 48"	1985 1st St. 30"	1985 1st St. 54"	1986 1st St. 54"	1985 2nd St.	1986 2nd St.	1985 3rd St.	1986 3rd St.	1985 4th St.	1986 4th St.
VOLATILES:													
1,1,1-Trichloroethane	-	16.6700	-	-	7.1000	0.5700	0.0800	-	-	<.012	0.0800	-	0.0800
1,1,2,2-Tetrachloroethane	.91	0.4900	-	-	0.3000	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	1.7000	1.5307	-	-	1.8000	0.0630	-	-	-	-	-	-	-
1,1-Dichloroethane	0.360	10.5300	<.056	-	4.6000	0.1300	-	-	-	-	-	-	-
1,1-Dichloroethene	0.7100	NM	<.056	-	5.3000	0.1300	-	-	-	-	-	-	-
1,1-Dichloroethylene	NM	0.1673	NM	-	NM	NM	-	NM	-	NM	-	NM	-
1,2-Dibromoethane	<0.065	NM	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichlorobenzene	NM	-	NM	-	NM	NM	-	NM	-	NM	-	NM	-
1,2-Dichloroethane	9.100	14.0400	0.1200	-	9.2000	0.5100	0.1200	-	-	-	-	-	-
1,2-Dichloropropane	0.360	-	-	-	0.6000	9.3000	-	1.5000	-	<.01	-	-	-
1,3-Dichlorobenzene	NM	-	NM	-	NM	NM	0.0043	NM	-	NM	-	NM	-
1,4-Dichlorobenzene	NM	-	NM	-	NM	NM	0.0112	NM	-	NM	-	NM	-
2-Chloroethyl Vinyl Ether	-	NM	-	-	-	-	-	-	-	-	-	-	-
3-Chloropropene	-	NM	-	-	-	-	-	-	-	-	-	-	-
Acrolein	-	NM	-	-	-	-	-	-	-	-	-	3.9000	-
Acrylonitrile	-	-	-	-	-	-	-	-	-	-	-	2.9000	-
Benzene	0.052	0.0200	-	-	0.0440	-	0.0700	-	-	58.000	-	3.9000	-
Bromodichloromethane	-	-	-	-	-	-	0.3800	-	-	-	-	-	-
Bromoform	-	-	-	-	-	-	0.5403	-	-	-	-	-	0.0560
Carbon Tetrachloride	3.800	2.1700	-	0.0600	10.0000	0.8100	1.0900	0.0990	-	11.0000	0.3800	-	0.2000
Chlorobenzene	-	-	-	-	<0.01	-	-	-	-	-	-	-	-
Chloroethane	-	NM	-	-	-	-	-	-	-	-	-	-	-
Chloroform	1.1000	0.1896	-	-	0.4200	-	0.1891	-	-	-	-	<0.057	0.0336
Dibromochloromethane	-	NM	-	-	-	-	-	-	-	-	-	-	-
Dichloromethane	NM	-	NM	0.1516	NM	NM	0.2124	NM	0.0658	NM	0.3090	NM	2.080

... volatile loadings cont'd

LOADINGS (kg/day)	1985 1st St. 42"	1986 1st St. 42"	1985 1st St. 48"	1986 1st St. 48"	1985 1st St. 30"	1985 1st St. 54"	1986 1st St. 54"	1985 2nd St.	1986 2nd St.	1985 3rd St.	1986 3rd St	1985 4th St.	1986 4th St.
VOLATILES: (Cont'd)													
Ethylbenzene	<.065	-	-	-	<0.01	<.03	-	-	-	60.0000	-	9.6000	-
Meta- & Para- Xylene	<.065	-	-	-	<0.01	<.03	-	-	-	-	-	-	-
Methylene Chloride	-	NM	-	-	0.2200	<.03	-	0.1600	-	0.1800	-	-	-
Ortho- Xylene	<.065	-	-	-	<0.01	<.03	-	-	-	-	-	-	-
Pentachloroethane	<.065	NM	-	-	<0.01	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	120.0000	-	-	-
Tetrachloroethylene	6.3000	3.0000	-	0.0900	7.10000	0.0730	0.8200	0.0730	-	-	0.1100	-	5.6000
Toluene	<.065	0.0800	-	-	<0.01	-	-	-	-	3.4000	-	0.7300	-
Trans-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	0.6100	-	-	-	2.3000	0.1200	-	-	-	<0.12	-	-	-
Trichloroethylene	NM	NM	NM	-	NM	NM	0.3810	NM	-	NM	-	NM	0.1160
TRS-1,2-Dichloroethylene	NM	0.0000	NM	-	NM	NM	0.0022	NM	-	NM	-	NM	-
Vinyl Chloride	<0.013	NM	-	-	-	<0.06	-	-	-	-	-	-	-
TOTAL LOADINGS:	24.0920	48.8876	0.1200	0.3016	48.9840	11.7060	3.9005	1.8320	0.0658	252.5800	0.8790	21.0300	8.1656

1985 Total: 360.3 (source: Jan. 1986 MOE/DOE Pollution Investigation)
1986 Total: 62.2 (source: May 21/1986 MISA Sequential sampling)
NM - not measured
- not detected

TABLE 2: SEQUENTIAL #1: 21/05/86 AMBIENT DATA CORRELATION MATRIX

	stn. no.	dst. off	time	CCl_4	PERC.	HCBD	HCE	HCB
stn. no.	1.00000							
dst. off	-.12050	1.00000						
time	-.01431	-.04228	1.00000					
CC14	-.14353	-.55028*	-.12851	1.00000				
Perc.	.04605	-.58738*	-.06564	.74300*	1.00000			
HCBD	.14206	-.30335*	-.06316	.37841*	.47438*	1.00000		
HCE	.17138	-.35526*	-.08992	.40364*	.67924*	.74057*	1.00000	
HCB	.12174	-.16192	-.01657	.17940	.21865*	.57567*	.33573*	1.00000

Critical value (1-tail. .05) = + or - .16635
Critical value (2-tail. .05) = +/- .19745
N = 99
* = significant correlation

EFFLUENT MONITORING

Introduction and Purpose:

In order to gain insight into variability inherent in industrial discharges, a long term monitoring program was initiated. The purpose of this component is to document the range of selected target compounds and provide a measure of daily and seasonal variability.

Methods:

Staff from Southwest Region of the Ministry of the Environment obtained samples randomly on a twice weekly schedule commencing May 15th, 1986. Six outfalls at Dow Chemical (1st St. (42", 48", 54"); 2nd St.; 3rd St.; and 4th St.) and 3 at Polysar (72"; Cole Drain; and Bio-ox) were sampled.

A custom designed basket sampler enabled two bottles to be filled simultaneously at approximately mid-depth in each effluent stream. Parameters to be tested included chlorinated aromatics, volatiles, mercury, cadmium, lead, nutrients and conventionals. Particular care was taken to ensure that all air was excluded from the 8 oz. volatile sample (i.e. no headspace).

Samples were shipped the same day or kept refrigerated and shipped the following day via courier overnight delivery.

Results and Discussion:

Appendix 3 provides results of conventional parameters and chlorinated organics measured to date. An arithmetic mean, standard deviation and range of values provides some indication of the degree of variability observed, particularly in the Dow 42" outfall located in the First Street complex, and in the Cole Drain. Compounds of note are hexachloroethane, hexachlorobutadiene, 2,4,5-Trichlorotoluene,

Hexachlorobenzene and Octachlorostyrene. In general, levels monitored from Dow 42" effluent were 1-2 orders of magnitude higher than other outfalls, with the exception of the Cole Drain (see Table 3). The latter however, appears to be much more widely fluctuating with less consistency between readings. Loadings, based on a mean discharge for each outfall and mean effluent concentrations are presented along with summary statistics in Appendix 3. A comparison of loading trends for the period November, 1985 to September, 1986 is provided in Table 4 and in Figures 11-15. Reductions for most parameters during this interval were typically an order of magnitude. One exception to this occurred for octachlorostyrene where loadings did not appear to differ significantly. 2,4,5-Trichlorotoluene was not measured during 1985 and thus a comparison was not possible.

Loading trends (Figures 11-15) indicate increases for several parameters (Perc., HCBD, HCE) at the Dow 4th St. sewer since 1985. This is attributed to the diversion of the highly contaminated 30" acid tile sewer to the 4th St. outfall via a newly constructed settling pond. Increases in volatile loadings at the Dow 42" and 48" sewers during May 21, 1986 sequential sampling as compared to 1985, reflected an excursion of high volatile loadings. The long-term average based on twice weekly sampling (see Part II: Appendix 3) was more consistent with the total volatile flux estimated from 1985 results.

TABLE 3: TWICE WEEKLY EFFLUENT SAMPLING - SUMMARY TO SEPTEMBER 26, 1986

STATION (SIS/IMIS STN. NO.)	HEXACHLOROETHANE ng/L			HEXACHLORO-BUTADIENE ng/L			2,4,5-TRICHLORO-TOLUENE ng/L			HEXACHLORO-BENZENE ng/L			OCTACHLORO-STYRENE ng/L		
	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
Polysar 72" (70220)	1.0	5.0	1.8	6.0	48	23.7	1.0	1.0	1.0	1.0	20	4.8	1.0	14	3.5
Cole Drain (7)	1.0	480	45.4	1.0	2500	408.6	1.0	136	19.1	1.0	650	27.7	1.0	310	13.5
Dow 42" (1090220)	1.0	1370	310.8	1.0	1600	367.3	1.0	3000	962.2	1.0	900	117.1	1.0	320	53.6
Dow 48" (1090320)	1.0	20	2.9	1.0	1200	64.0	1.0	32	3.9	1.0	200	10.9	1.0	93	4.3
Dow 54" (1090520)	1.0	440	30.3	1.0	710	66.9	1.0	30	9.0	1.0	54	6.6	1.0	53	3.6
Dow 2nd St. (1090620)	1.0	70	8.2	1.0	300	24.1	1.0	15	5.3	1.0	25	2.6	1.0	10	1.8
Dow 3rd St. (1090720)	1.0	30	4.5	1.0	1500	70.1	1.0	37	4.3	1.0	54	6.6	1.0	79	4.7
Dow 4th St. (1090920)	1.0	2250	181.1	1.0	260	17.5	1.0	81	5.5	1.0	21	4.2	1.0	8	1.6

N.B. - Detection limit: 1 ng/L (1 ppt)
- For specific sample results and loadings see Appendix 3

TABLE 4: COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (kg/day)

SOURCE	HEXACHLOROETHANE			HEXACHLOROBUTADIENE			2,4,5-TRICHLOROTOLUENE			HEXACHLOROBENZENE			OCTACHLOROSTYRENE		
	1985a	1986b	1986c	1985a	1986b	1986c	1985a	1986b	1986c	1985a	1986b	1986c	1985a	1986b	1986c
Polysar 72"	0.00003	-	0.00005	0.0006	0.0008	0.0006	NM	-	-	0.0001	-	0.0001	0.00006	0.00004	0.0001
Cole Drain	0.029	0.005	0.00	0.105	0.071	0.03	NM	-	-	0.0013	0.0004	-	0.0003	0.0005	0.00
Dow 42"	0.13	0.008	0.018	0.19	0.02	0.021	NM	0.128	0.056	0.009	0.006	0.007	0.003	0.005	0.003
Dow 48"	0.0005	0.0001	0.0002	0.0009	0.0007	0.0041	NM	0.002	0.002	0.001	0.0003	0.0002	0.0001	-	0.0003
Dow 30"	0.028	NM	NM	0.019	NM	NM	NM	NM	NM	0.028	NM	NM	0.0016	NM	NM
Dow 54"	0.0216	0.0010	0.0009	0.0018	0.0012	0.002	NM	0.0004	0.0003	0.0006	-		0.0001	-	0.0001
Dow 2nd St.	0.0011	0.0005	0.0005	0.0012	0.0009	0.0014	NM	-	0.0003	0.0003	0.0002	0.00015	-	0.0001	0.0001
Dow 3rd St.	0.0016	0.0001	0.00036	0.0019	0.0007	0.0055	NM	0.0003	0.00034	0.0011	0.0002	0.0005	0.0001	0.0002	0.00038
Dow 4th St.	0.0035	0.0012	0.0725	0.0026	0.0025	0.007	NM	0.0013	0.0022	0.003	0.0014	0.0017	0.0002	-	0.0006
TOTAL LOADINGS:	0.215	0.016	0.093	0.323	0.051	0.0716	-	0.13	0.119	0.044	0.0085	0.0097	0.0055	0.0058	0.0046
% CHANGE															
1985a-1986b	- 92.6			-84.2			NA			-80.7			+ 5.5		
1985a-1986c	- 56.8			-77.8			NA			-78.0			-16.4		
1986b-1986c	+481			+40.3			-8.5			+14.1			-20.7		

a - MOE/EC Jan. 1986 St. Clair River Pollution Investigation Report
b - May 21, 1986 MISA Sequential
c - 1986 MISA 2x weekly;
d - 1985 samples taken before Polysar
NM - not measured
NA - not applicable
- not detected

TABLE 7: ST. CLAIR RIVER MISA RESULTS TO DATE FOR ECOSYSTEM STATION WATER GRABS

VOLATILES:

RIVER STATION	1,1-Dichloroethane (ug/l)		1,1,1-Trichloroethane (ug/l)		1,2-Dichloroethane (ug/l)		CCl_4 (ug/l)		Trichloroethylene (ug/l)		1,1,2-Trichloroethane (ug/l)		Tetrachloroethylene (ug/l)	
	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.
25 Can	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25 US	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
132	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
203	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
206	3	ND	5	ND	ND	ND	1	ND	ND	ND	ND	ND	2	3
211	ND	ND	2	ND	1	ND	ND	ND	ND	ND	ND	ND	1	2
216	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	2
18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
218	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
214 Can	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
214 US	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CLADOPHORA

Cladophora was collected from the St. Clair River during the periods July 21-24 and September 16-18, 1986.

The following sites were visited and cladophora obtained during both surveys:

Stn. 132, 132b, 18, 214 (Can.)

Additional samples were obtained from stations 25 (Can.), 216, and 214 (U.S.) during July and station 203 in September.

Following collection, samples were freeze-dried, ground and submitted for PCB/OCs, chlorinated aromatics, chlorinated phenols, PAHs and metals.

A final data set was received in late May, 1987; however, these results require analysis and interpretation.

A problem encountered during field surveys was the unavailability of cladophora at all sites. This has been attributed to a number of factors including site-specific substrate, depth, temperature and flow characteristics as well as the presence of potentially toxic compounds in the water column.

CENTRIFUGING

Subsurface (1m depth) and bottom (within 20cm of bottom) depths at ecosystem stations were selected for centrifuging of the water column. In addition, Polysar and Dow sewers were centrifuged from mid-depth on each of 3 cruises.

Centrifuged particulate data from ecosystem stations is presented in Appendix 5. Data from centrifuged industrial effluent is pending due to some difficulties encountered downloading from the IMIS (Industrial Monitoring Information System) database.

Fig 11: COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (g/day)

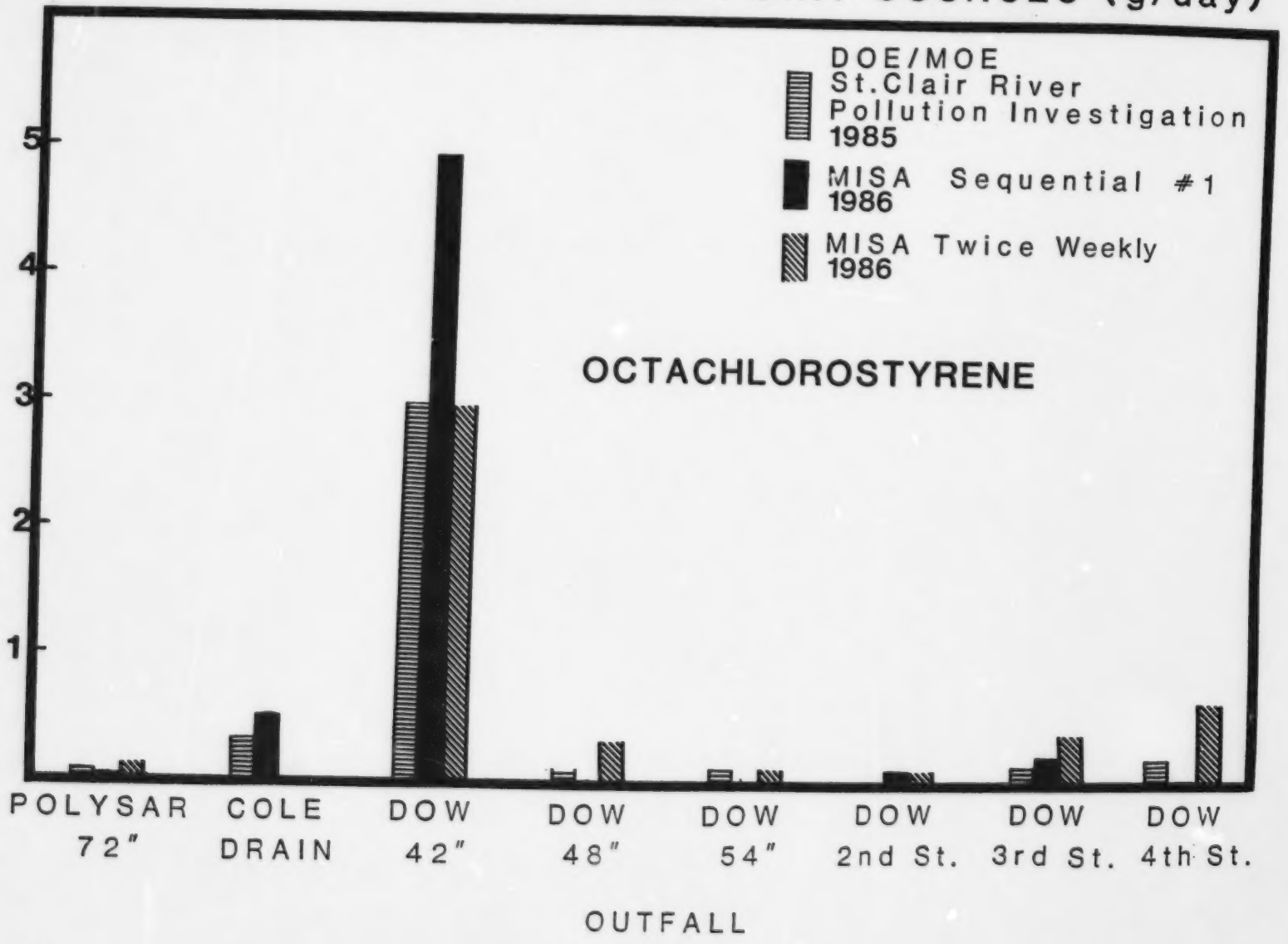


Fig 12:

COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (g/day)

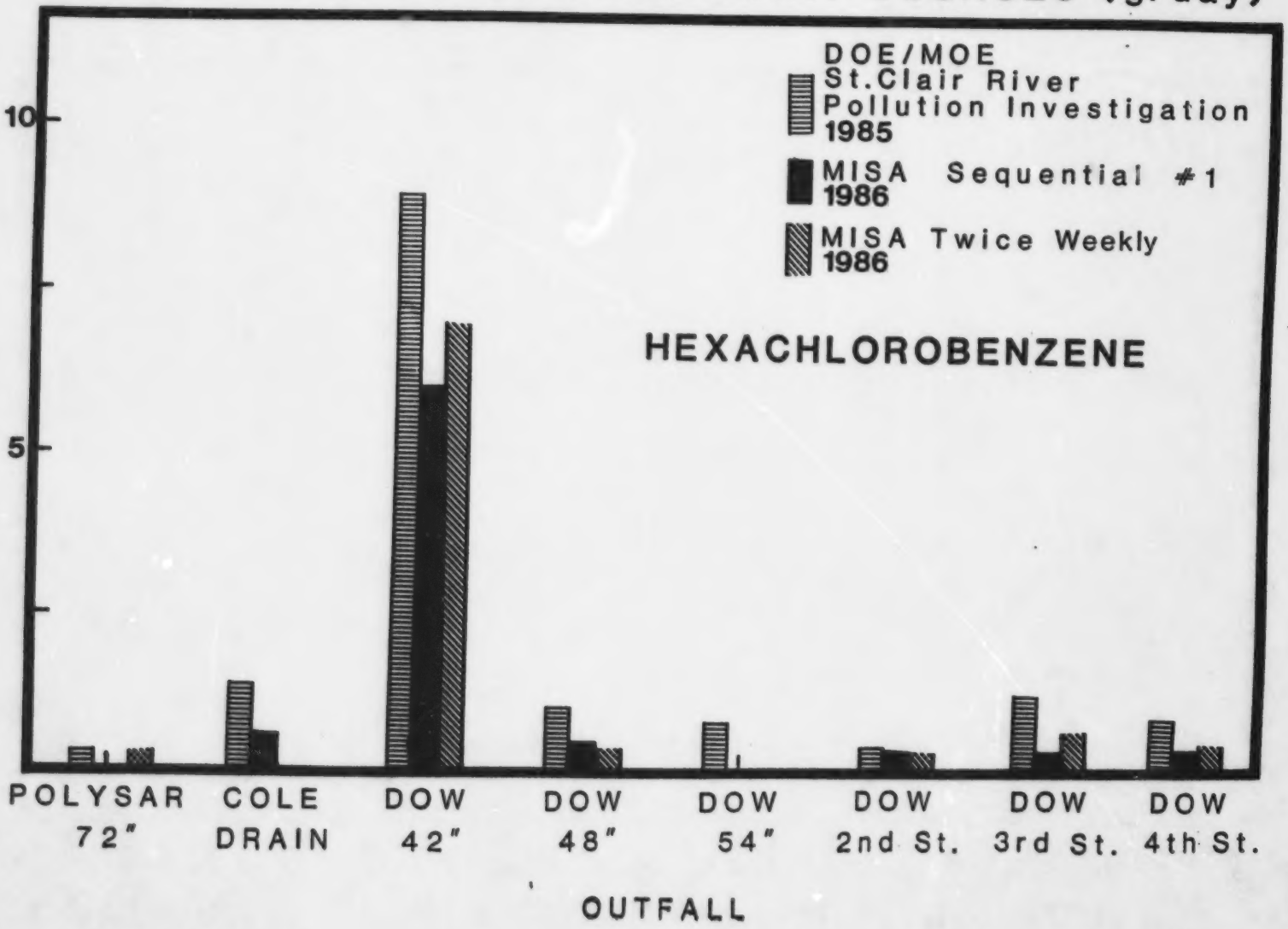


Fig 13:

COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (g/day)

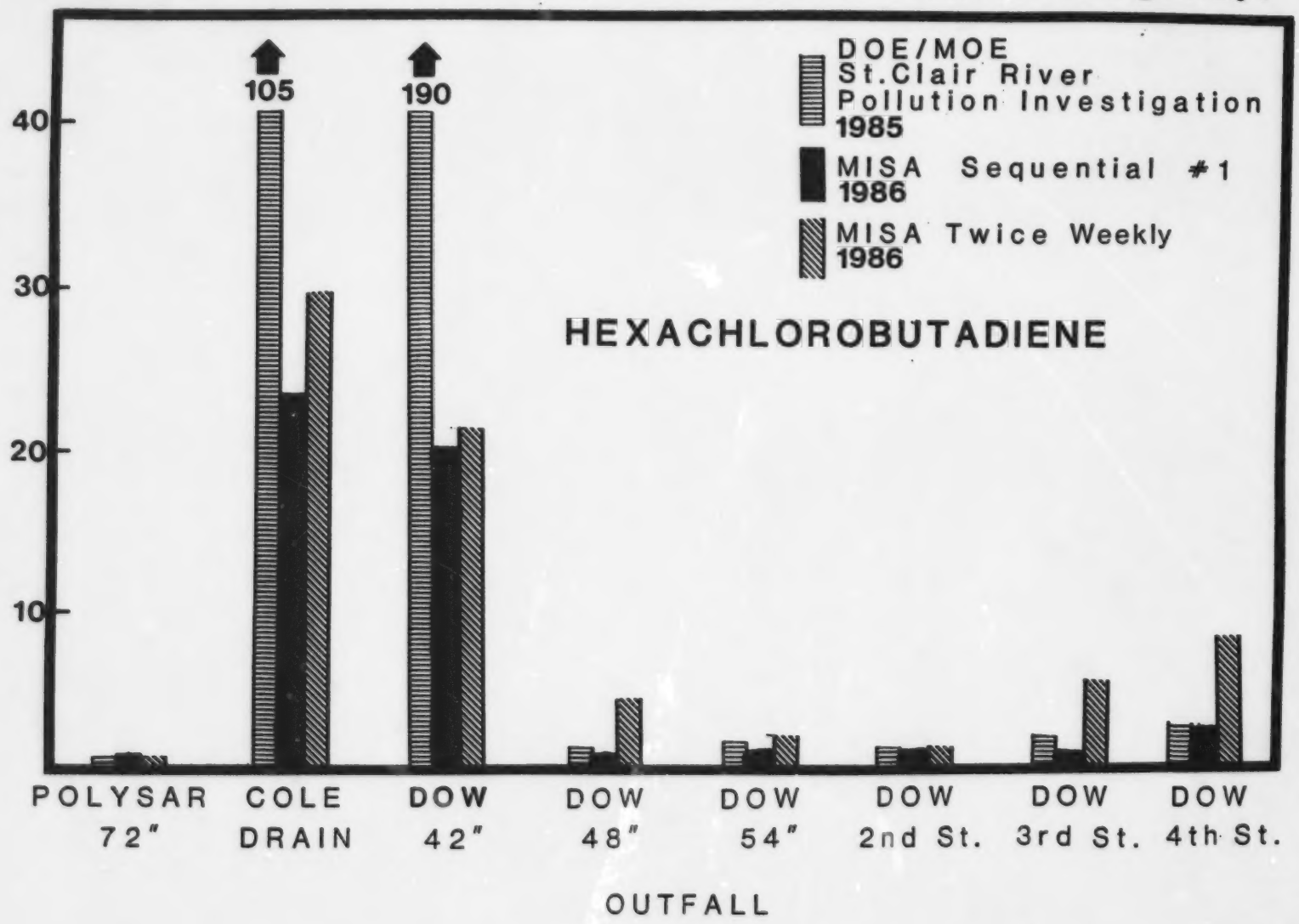


Fig 14:

COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (g/day)

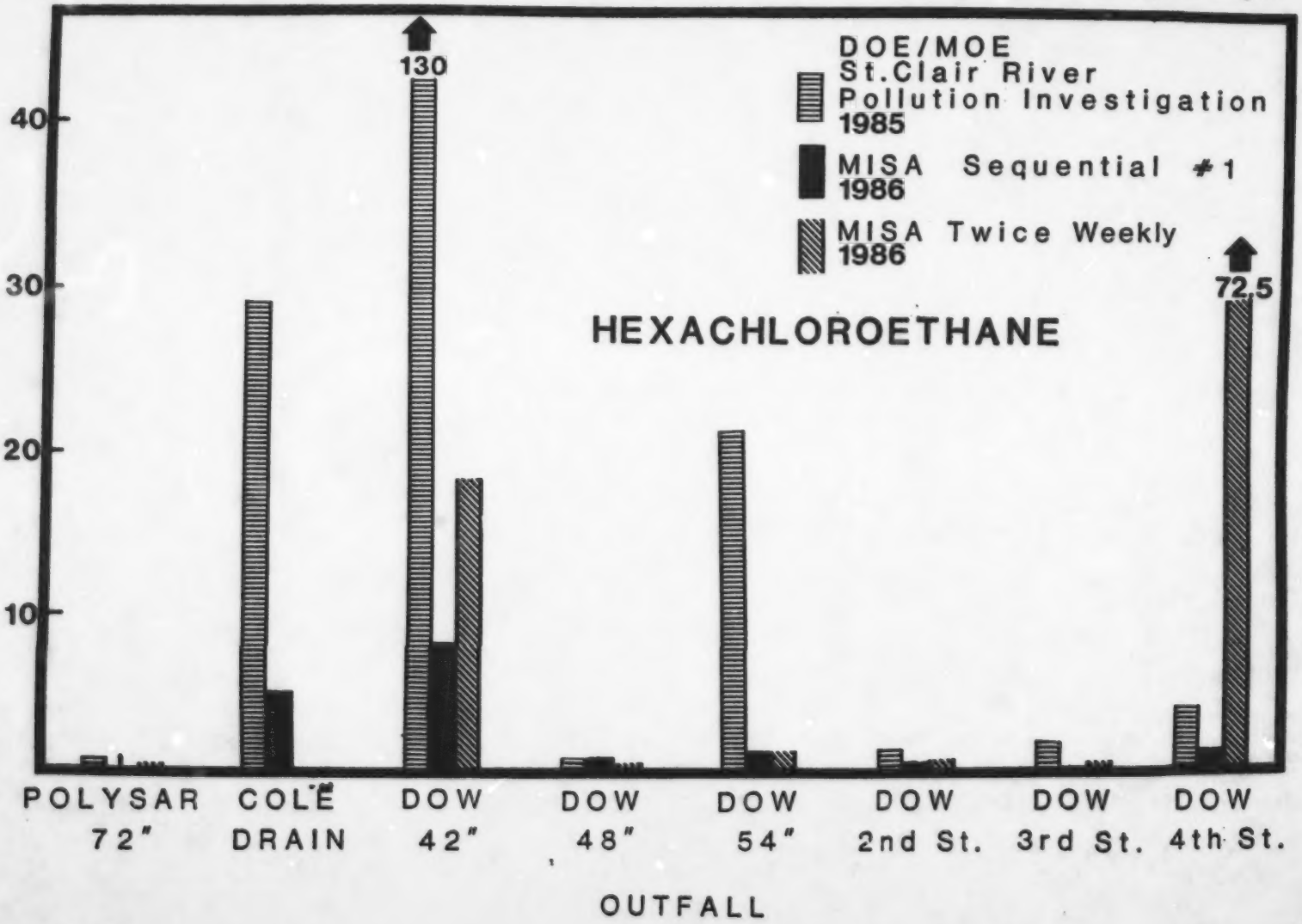
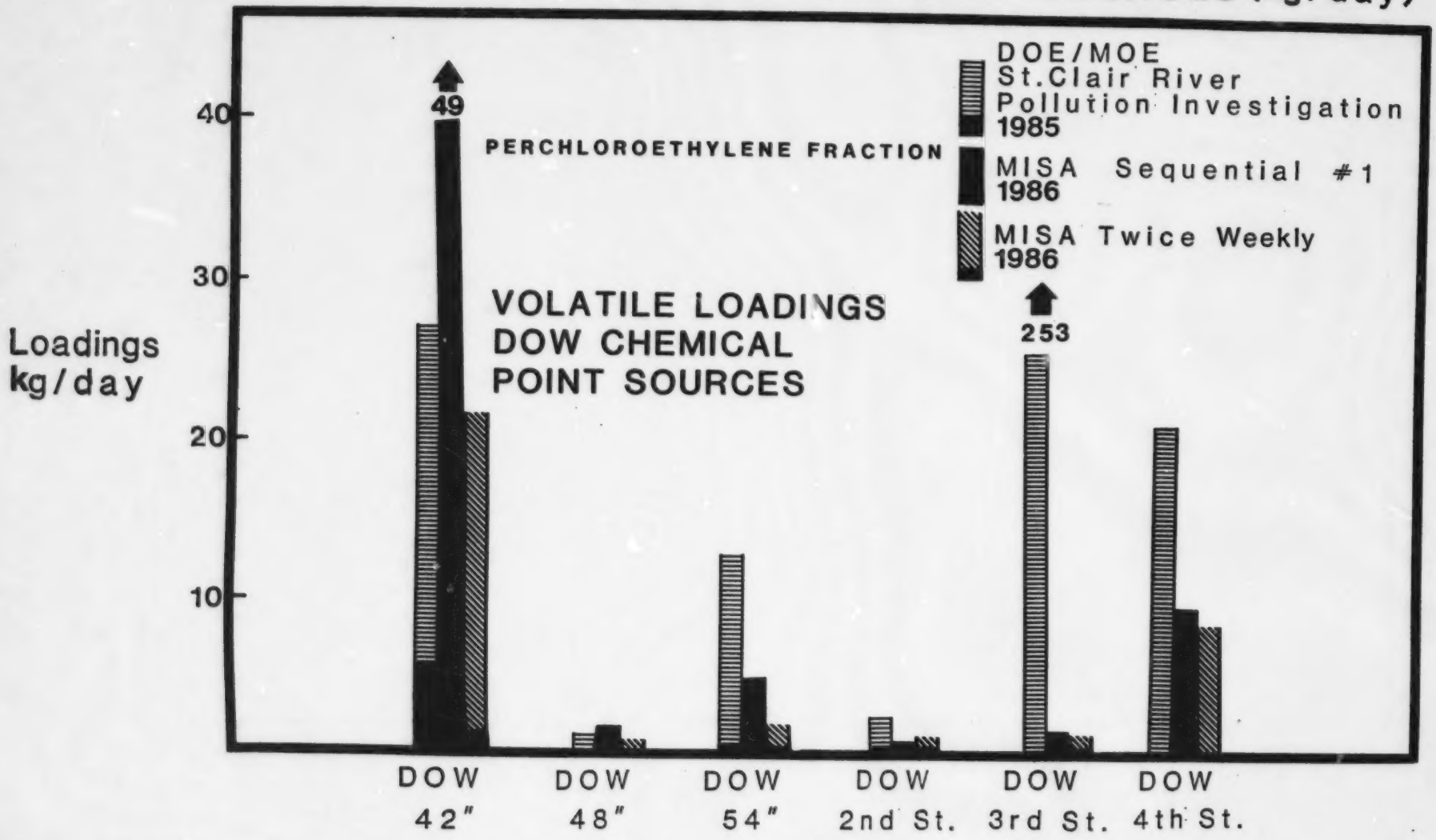


Fig 15:

COMPARISON OF LOADINGS VERSUS TIME FOR SELECTED ST. CLAIR RIVER POINT SOURCES (kg/day)



ECOSYSTEM MONITORING

SPORTFISH

Collection of sportfish were requested for Lake St. Clair in 1986. Table 5 summarizes the collection proposal. No results are available to date.

JUVENILE FISH

Collections of juvenile fish were made at the following locations at the St. Clair River.

1. Port Huron, Michigan
2. Perch Creek — Lower Lake Huron

3. Control at Point Edward
4. Suncor
5. Lambton Generating Station — St. Clair River
6. Port Lambton
7. South Channel

The common species collected throughout the study area was the emerald shiner, however, spottail shiners were also taken at Port Huron, Michigan, Lambton Generating Station and South Channel. These collections will facilitate the inter-species comparison.

Only results for volatile organics are available at this time for the 1986 collections. A summary of residue data from 1985 and 1986 collections is provided in Table 6.

Of interest are the elevated PCB residues found in the 1985 emerald and spottail shiner collections at Suncor and the Lambton Generating Station. Results from the 1986 collections are needed to assess these findings.

TABLE 5: LAKE ST. CLAIR FISH COLLECTION PROPOSAL

LOCATION: Lake St. Clair
4228/8240
Essex & Kent Cos.

MOE REGION: Southwestern
MNR REGION: Southwestern
MNR DISTRICT: L. St. Clair FAU

YEAR: 1986
SUBMISSION NO.: FC00576
FIELD SAMPLE NOS. ISSUED: A3201-A3570
SAMPLER:

SPECIES	FIELD TEST (FT) CODE	NO. REQ'D	NO. OF FISH TO BE ANALYSED									SPECIAL INSTRUCTIONS
			HG	METALS	As,Se	ALKYL LEAD	PCB-OC	2,3,7,8 -TCDD	PCDD/ PCDF	PAH	OTHER	
Carp	FT7	30	30	10	10	*	30	5	5	5	CB,CP 5	Double fillets, package and submit Dioxin fillets separately
Ch. Catfish	FT7	30	30	10	10	*	30	5	5	5	5	"
Walleye	FT7	30	30	10	10	*	30	5	5	5	5	"
N. Pike	FT7	30	30	10	10	*	30	5	5	5	5	"
Y. Perch	FT7	30	30	10	10	*	30	5	5	5	5	"
S.M. Bass	FT7	30	30	10	10	*	30	5	5	5	5	"
W. Bass	FT7	30	30	10	10	*	30	5	5	5	5	"
Pumpkinseed	FT7	30	30	10	10	*	30	5	5	5	5	"
Rock Bass	FT7	30	30	10	10	*	30	5	5	5	5	"
W. Sucker	FT7	30	30	10	10	*	30	5	5	5	5	"
F.W. Drum	FT7	30	30	10	10	*	30	5	5	5	5	"

* Alkyl lead on any over 1 ppm lead

TABLE 6: ST. CLAIR RIVER - CONTAMINANTS IN JUVENILE FISH (ng/g)

	TIME SAMPLED	SPECIES	N	PCB	HCB	OCTA-CHLORO-STYRENE	HEXA-CHLORO-BUTADIENE	PENTA-CHLORO-BENZENE	VOLATILES		
									N	TETRA-CHLORO-ETHYLENE	CARBON TETRA-CHLORIDE
Sarnia Control	October, 1986	E.S.			TO BE ANALYZED				1	TR	ND
Suncor	October, 1985	E.S.	5	456 ± 117	69 ± 43	30 ± 19	N.A.	N.A.	1	380	ND
	October, 1986	E.S.			TO BE ANALYZED				1	31	4
Lambton Gen. Station	October, 1985	S.S.	4	422 ± 152	60 ± 13	81 ± 22	N.A.	N.A.	1	220	ND
	October, 1986	E.S.			TO BE ANALYZED				1	12	ND
Port Lambton	October, 1985	E.S.		N.A.	N.A.	N.A.	N.A.	N.A.	1	320	ND
	October, 1986	E.S.			TO BE ANALYZED				1	4	ND
South Channel	October, 1986	E.S.			TO BE ANALYZED				1	ND	ND

E.S. - Emerald Shiner

While octachlorostyrene and hexachlorobenzene residues in the 1985 collections have declined considerably from measured 1983 levels, concentrations at Suncor and the Lambton Generating Station are still much elevated when compared to Great Lakes' background concentrations.

Tetrachloroethylene accumulations in the emerald shiner collections continue to decrease following the Dow Chemical spill in the fall of 1985.

IN-PLACE POLLUTANTS

The in-place pollutant work was comprised of six aspects: bottom water chemistry; bulk sediment chemistry; geochemical fractionation of the sediments; contaminant residues in benthic invertebrates; and sculpins and benthic enumeration work. Collections of water and sediments for chemical analysis were completed in October at 9 stations between Sarnia Bay and Chenal Ecarte. Collections of benthic organisms were made at 7 stations and sculpins at 6 stations.

Interim results on water chemistry have been received. Analytical results for all other aspects except bulk sediment chemistry are being conducted by external consultant laboratories.

SEDIMENT BIOASSAYS

Sediment from the 9 stations sampled under the in-place pollutant program have been used for the sediment bioassay program. Bioassay test results pertaining to the lethality of the sediments to Hexagenia, Hyallela and fathead minnows indicate low mortality at all stations with the exception of two stations below the Dow 1st St. outfalls. Significant mortality was observed for mayflies and for fathead minnows, but to a lesser extent. Tissue analysis for surviving test organisms are pending. Contaminant residues of the test organisms surviving the exposure will be analysed at an external consultant laboratory. Results are pending.

EFFLUENT BIOASSAYS

Acute lethality testing of effluents from Dow 1st St. sewers (11/06/86) and Dow 4th St. (18/09/86) has been non-lethal to test organisms. Further testing has been arranged through the Aquatic Toxicity Unit (Water Resources Branch) and District personnel to enable sampling during the 1987 field season. Emphasis will be placed on sub-lethal and chronic tests to determine if longer term effects are noted.

MUTAGENICITY TESTING

Mutagenicity testing by MOE has revealed no positive response for samples analyzed thus far. As a result, further testing is not anticipated, unless chemical effluent characterization indicates a need. This would be based on the presence of mutagenic compounds in effluent.

WATER QUALITY GUIDELINES

The development of Provincial Water Quality Objectives (PWQO) is charged to "Blue Book" Working Group 1. Several staff of the Bioassessment Unit are members of this Group and in 1986 work progressed toward settling several water quality objectives pertinent to the St. Clair MISA study.

A final report on Benzenes and Substituted Benzenes is under preparation prior to approval by MOE. A draft report on Phenols and Substitued Phenols is available but requires peer review prior to acceptance by MOE. Both documents suggest objectives which will eventually become PWQO values.

CLAM EXPOSURE

Introduction and Purpose:

Clams collected from Balsam Lake were exposed in the St. Clair River. Results enabled contaminant levels and bioavailability to be mapped for various compounds. Clams have been used previously to document point-sources because of their utility to integrate or bioaccumulate contaminants over time. The vertical distribution of contaminants was also addressed through clam deployment at bottom and mid-depth.

Methods:

Clams were harvested from Balsam Lake June 11, 1986 by means of diver retrieval. Sufficient numbers were obtained to deploy 6 clams at two depths for all stations. Additional clams were collected for mutagenicity assays. Six clams were submitted directly as controls and water samples were obtained at both surface and bottom. Clam tissues were submitted for volatiles and chlorinated aromatics analysis. Field preparation included shucking, rinsing and wrapping of tissues in solvent rinsed foil. Clams for volatiles analyses were transported live to the consultants' office for preparation as per the protocol outlined in Appendix 1 (Preliminary Report - Volume I: Part II).

Clams were transported to the field in 30" x 48" bioassay bags and kept cool. Aeration was applied as necessary until deployment which occurred on June 12 and 13.

Eleven stations were selected for clam deployment (Fig. 16). A similar station grid was utilized for additional sampling components (centrifuging, benthos, macrophytes) and is referred to as the Ecosystem grid.

Clam cages were constructed from wire mesh and were attached to shore by fine stainless steel cable. An empty 1 l bottle was used to buoy the mid-depth cage while lead weights fixed the bottom cage in place. All cages were deployed at approximately 18 feet depth. Photographs and shore references were utilized to locate stations for future visits.

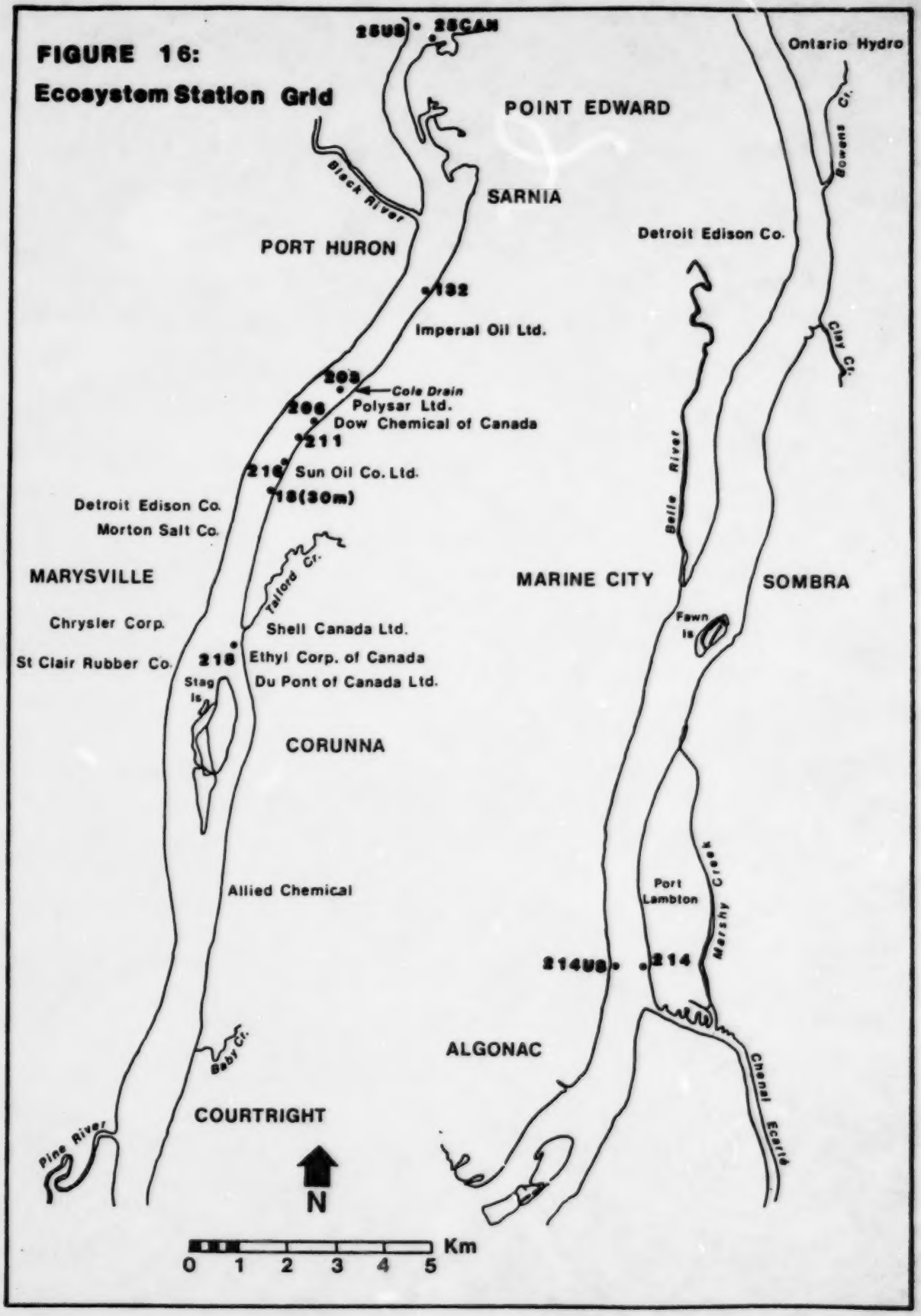


FIGURE 16:
Ecosystem Station Grid
28US
28CAN
POINT EDWARD
Ontario Hydro
Bowen Ct.
Black River
SARNIA
PORT HURON
Detroit Edison Co.
Clay Ct.
182
Imperial Oil Ltd.
203
Cole Drain
206
Polysar Ltd.
Dow Chemical of Canada
211
216
Sun Oil Co. Ltd.
18(30m)
Detroit Edison Co.
Morton Salt Co.
Belle River
Tallord Ct.
MARYSVILLE
MARINE CITY
SOMBRA
Chrysler Corp.
Shell Canada Ltd.
Fawn Is.
St Clair Rubber Co.
218
Ethyl Corp. of Canada
Du Pont of Canada Ltd.
Stag Is.
CORUNNA
Allied Chemical
Port Lambton
Marshy Creek
214US
214
ALGONAC
Baby Ct.
Channel Ecarte
COURTRIGHT
Pine River
N
Km
0 1 2 3 4 5

Bottom and sub-surface water samples were obtained on a monthly basis from all locations. Clams were initially retrieved July 14-15 after a 1 month exposure. Seven of 11 stations were recovered and 6 clams were removed from each cage. An additional 5 clams were removed from selected bottom cages for mutagenicity testing. At stations where cages were unrecoverable, new cages and freshly harvested clams were deployed with the exception of Station 25 US where additional equipment was not available.

This second exposure lasted a further 3 months until final harvesting October 26th. During this retrieval, only 3 of 10 stations were recovered.

Results:

A summary of available water data is presented in Table 7 for selected contaminants. Analysis of samples from Balsam Lake revealed less than detectable levels for all volatiles and chlorinated organics with the exception of α-BHC which occurred at levels of 1 and 3 ng/l in surface and bottom waters, respectively.

Some tissue has been analysed with available results presented in Table 8. Data is for single clams held in cages within 6" off bottom. Further tissue analysis for chlorinated aromatics is pending.

TABLE 7 (cont'd):

CHLORINATED ORGANICS:

RIVER STATION	HCE ng/l		HCBD ng/l		2,4,5-Trichloro toluene ng/l		HCB ng/l		OCS ng/l	
	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.
25 Can	3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND								
25 US	ND	4	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND								
132	ND	1	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND								
203	ND	ND	ND	ND	ND	ND	ND	7	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
206	ND	11	ND	11	ND	ND	ND	4	ND	ND
	ND	ND	3	30	ND	ND	2	6	1	1
211	1	2	3	ND	ND	ND	7	2	ND	ND
	ND	ND	3	5	ND	ND	3	2	ND	ND
216	10	ND	11	ND	ND	ND	ND	ND	ND	ND
	ND	ND	5	4	ND	ND	2	2	ND	1
18	10	10	6	9	ND	ND	ND	ND	ND	ND
	ND	ND	1	6	ND	ND	2	4	ND	ND
218	ND	3	ND	6	ND	ND	ND	ND	ND	ND
			ND	5	ND	ND	2	190	ND	86
214 Can	ND	3	ND	ND	ND	ND	ND	ND	ND	ND
214 US	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	5	ND	ND	ND	2	ND	ND

TABLE 8: SELECTED CONTAMINANTS MEASURED IN CLAMS EXPOSED IN THE ST. CLAIR RIVER, 1986 (NG/G)

LOCATION STATION NO.	EXPOSURE TIME	CHLOROFORM	BENZENE	PERC.	HCBD
132	1 month	2.6	5.1	-	-
132	1 month	15	14	-	-
206	1 month	3.6	3.5	-	40
206	1 month	-	22	11	37
216	1 month	8.3	14	29	24
216	1 month	4.9	8.4	4.2	36
18	1 month	6.7	8.4	12	135
214	19 weeks	7.8	10	-	-
18	15 weeks	10	12	3.9	-
18	15 weeks	11	11	4.3	6.1
18	15 weeks	5.3	9.3	4.4	-
218	15 weeks	2.8	16	-	-
218	15 weeks	8.2	10	-	-

MACROPHYTES

Information on submerged macrophyte biomass was required for modelling purposes. Two large scale surveys have been completed by the U.S. Fish and Wildlife Service and data from these surveys have been used for the biomass estimate. A 1978 survey (D. Schloesser and B. Manny) produced an estimate of 2080 metric tonnes (Ash Free Dry Weight/Yr). A more recent survey in 1983-84 (P. Hudson et al) estimate 2290 metric tonnes (AFDW/yr.). The agreement between these estimates indicates the stability of the biomass production over the period from 1978 to 1984.

Twenty plant samples were collected at seven locations along the Canadian Shore (see below and Figure 17) and submitted for organochlorine pesticides, PCBs and chlorinated benzenes.

	Station Location	Species	Sample Number
1.	Sarnia Bay	Myriophyllum	1
		Vallisneria	2
2.	d/s Esso	Potamogeton gramineus	3
3.	d/s Polysar	" "	4
4.	d/s Dow	" "	5
5.	d/s Suncor	" "	6
6.	d/s Talford Creek	" "	7
		Myriophyllum	8
7.	N.W. Shore Stag Island	Potamogeton gramineus	9
		Myriophyllum	10

Ten samples were freeze-dried and ten samples were air-dried to evaluate how sample preparation might affect the concentrations of organic chemicals detected in plant tissues. Analytical results are presented in Table 9.

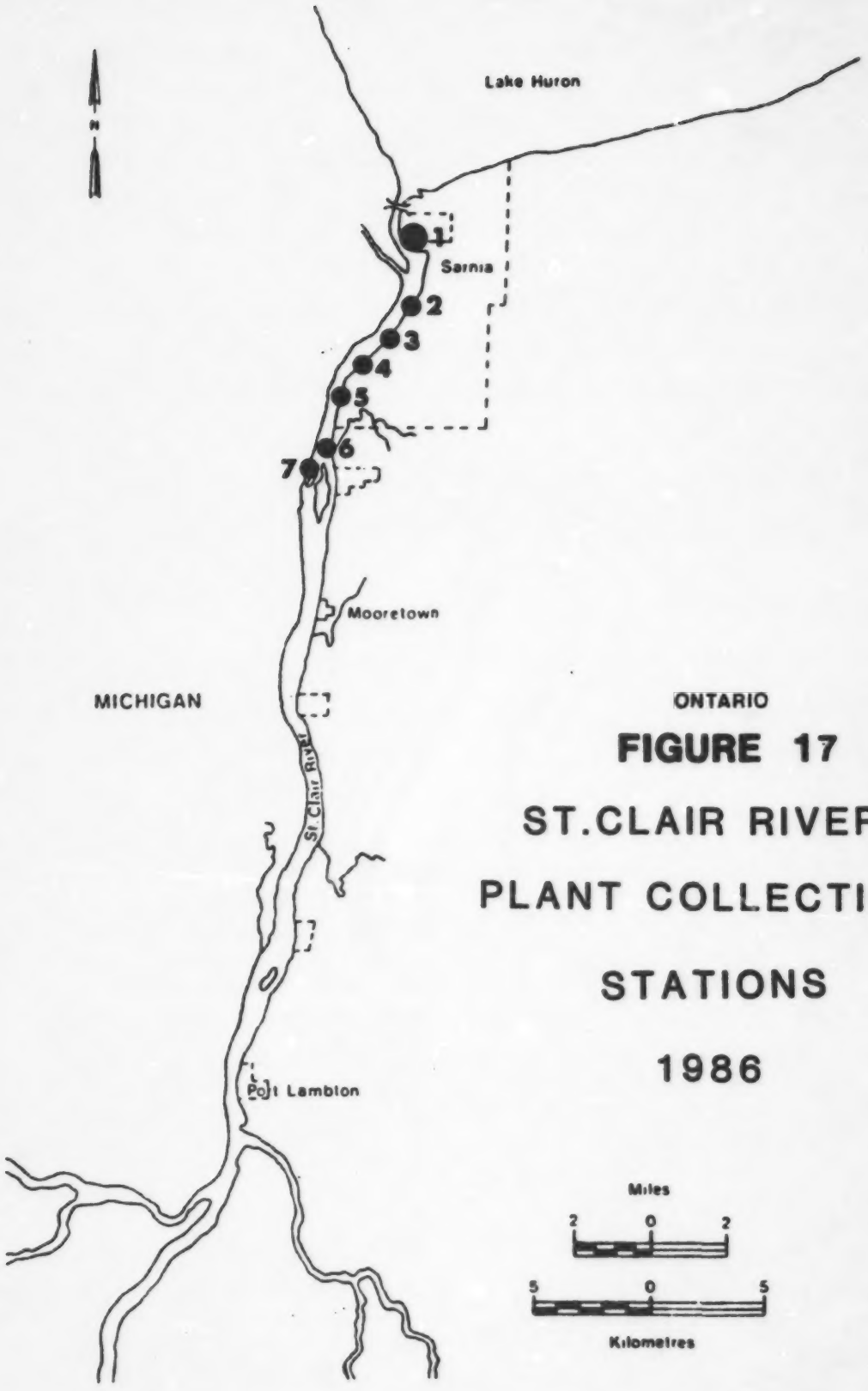


FIGURE 17

ST.CLAIR RIVER

PLANT COLLECTION

STATIONS

1986

TABLE 9: SUMMARY OF THE ANALYTICAL RESULTS FOR MACROPHYTE SAMPLES COLLECTED FROM THE ST. CLAIR RIVER - SEPTEMBER 23, 1986

Parameter	Sample No.	Stn. No.	Plant Species	Frozen	Dried
PP-DDE ng/g	1	1	Myriophyllum	2	6
	2	1	Vallisneria	L 1	25
	3	2	Potamogeton gramineus	L 1	13
	4	3	P. gramineus	L 1	2
	5	4	P. gramineus	L 1	2
	6	5	P. gramineus	L 1	11
	7	6	P. gramineus	L 1	L 1
	8	6	Myriophyllum	L 1	3
	9	7	P. gramineus	2	L 1
	10	7	Myriophyllum	2	L 1
Heptachlorepoxide ng/g	1	1	Myriophyllum	L 1	L 1
	2	1	Vallisneria	4	L 1
	3	2	Potamogeton gramineus	6	L 1
	4	3	P. gramineus	5	L 1
	5	4	P. gramineus	3	L 1
	6	5	P. gramineus	3	1
	7	6	P. gramineus	4	L 1
	8	6	Myriophyllum	3	L 1
	9	7	P. gramineus	4	L 1
	10	7	Myriophyllum	4	L 1
Octachlorostyrene ng/g	1	1	Myriophyllum	L 1	L 1
	2	1	Vallisneria	L 1	26
	3	2	Potamogeton gramineus	L 1	11
	4	3	P. gramineus	L 1	10
	5	4	P. gramineus	L 1	36
	6	5	P. gramineus	L 1	32
	7	6	P. gramineus	L 1	3
	8	6	Myriophyllum	L 1	L 1
	9	7	P. gramineus	L 1	4
	10	7	Myriophyllum	L 1	4
Hexachlorobutadiene ng/g	1	1	Myriophyllum	L 1	L 1
	2	1	Vallisneria	L 1	2
	3	2	Potamogeton gramineus	L 1	L 1
	4	3	P. gramineus	32	3
	5	4	P. gramineus	33	7
	6	5	P. gramineus	10	6
	7	6	P. gramineus	L 1	L 1
	8	6	Myriophyllum	L 1	4
	9	7	P. gramineus	10	L 1
	10	7	Myriophyllum	L 1	L 1

TABLE 9 (Cont'd)

Parameter	Sample No.	Stn. No.	Plant Species	Frozen	Dried
Pentachlorobenzene ng/g	1	1	Myriophyllum	L 1	L 1
	2	1	Vallisneria	L 1	8
	3	2	Potamogeton gramineus	L 1	5
	4	3	P. gramineus	L 1	L 1
	5	4	P. gramineus	3	2
	6	5	P. gramineus	2	2
	7	6	P. gramineus	L 1	L 1
	8	6	Myriophyllum	L 1	7
	9	7	P. gramineus	2	L 1
	10	7	Myriophyllum	L 1	2
Hexachlorobenzene ng/g	1	1	Myriophyllum	4	6
	2	1	Vallisneria	2	L 1
	3	2	Potamogeton gramineus	6	21
	4	3	P. gramineus	38	8
	5	4	P. gramineus	16	31
	6	5	P. gramineus	26	19
	7	6	P. gramineus	L 1	4
	8	7	Myriophyllum	L 1	41
	9	7	P. gramineus	10	L 1
	10	7	Myriophyllum	L 1	10
Hexachloroethane ng/g	1	1	Myriophyllum	L 1	L 1
	2	1	Vallisneria	L 1	2
	3	2	Potamogeton gramineus	L 1	L 1
	4	3	P. gramineus	L 1	L 1
	5	4	P. gramineus	L 1	L 1
	6	5	P. gramineus	L 1	L 1
	7	6	P. gramineus	L 1	L 1
	8	6	Myriophyllum	L 1	L 1
	9	7	P. gramineus	L 1	L 1
	10	7	Myriophyllum	L 1	L 1

L - less than

There appears to be little difference in tissues that were air-dried versus freeze-dried before submission; however there appears to be some differences on a parameter-by-parameter basis. Five and six organic compounds, respectively, were found in tissues that were air-dried versus freeze-dried. Concentrations of chemicals detected appeared to depend more on the type of chemical and/or location rather than the method of tissue preparation.

Compounds detected in both freeze-dried and air-dried plant tissues were hexachlorobutadiene (HCBD), pentachlorobenzene (QCB), hexachlorobenzene (HCB) and PP-DDE.

Hexachloroethane (HCE) and octachlorstyrene (OCS) were found only in air-dried samples while heptachlorepoxide was found only in freeze-dried samples.

BACTERIAL SLIMES

A diver inspection of the Canadian shoreline from Sarnia Bay to Talford Creek was conducted the week of June 9-13, 1986. The bottom was surveyed for the presence of slime growths and outfalls were similarly inspected. Very little slime growth was observed compared to observations from other years and the preceeding winter, during the monitoring of the Dow clean-up. The Polysar 66-inch sewer and an outfall from Imperial Oil (Biox plant and wastes from #11 and #12 separators) were discharging slime growths. The shoreline inspection was recorded using an underwater video camera.

Based on the absence of growth in June, a fall sampling was planned. Slime growths have been observed to peak in the colder months, however, growths had not developed as of October 30, 1986 and weather and other factors precluded sampling after this time. A sampling was attempted on October 30 by towing a net 1 meter below the surface along the Canadian near shore. A flow meter was fitted on the net to permit a loading estimate. A total of 3 tows were made and no slimes were captured.

It was decided that an estimate of slime growth loadings from the two sewers identified by the underwater photography could be accomplished; however, this remains to be calculated.

PHYTOPLANKTON

Biomass:

Also required for modelling purposes is an estimate of phytoplankton biomass in the St. Clair River. Following discussions with staff of the Aquatic Biology Section (Water Resources Branch), a method was developed to estimate phytoplankton biomass in the St. Clair River by measuring chlorophyll a. A relationship exists between phytoplankton biomass (cell volume) and chlorophyll a. This relationship has been established by means of samples collected at the Lambton Area Water Supply System situated at the head of the St. Clair River.

Four transects were established with chlorophyll a, Secchi disk and temperature information collected at each shoreline (Figure 18). This transect sampling was developed to evaluate differences between shoreline chlorophyll a values and to allow measurement of possible differences along the Canadian shoreline as a result of shoreline discharges.

Nine sampling runs were conducted over the period of May 15 to October 10 approximately on a bi-weekly basis. Findings from this work are attached in appendix 4 and in figures 19-21.

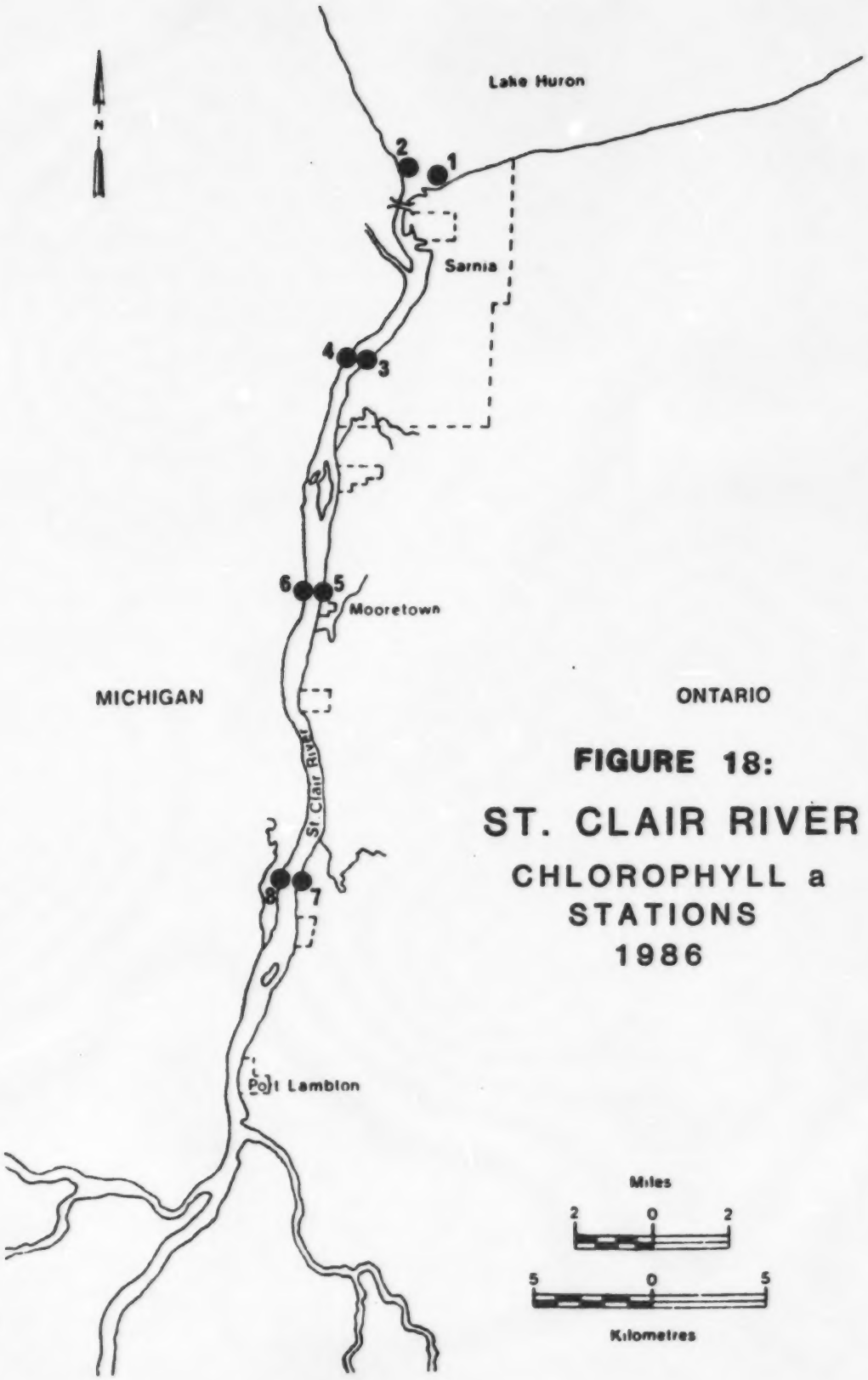
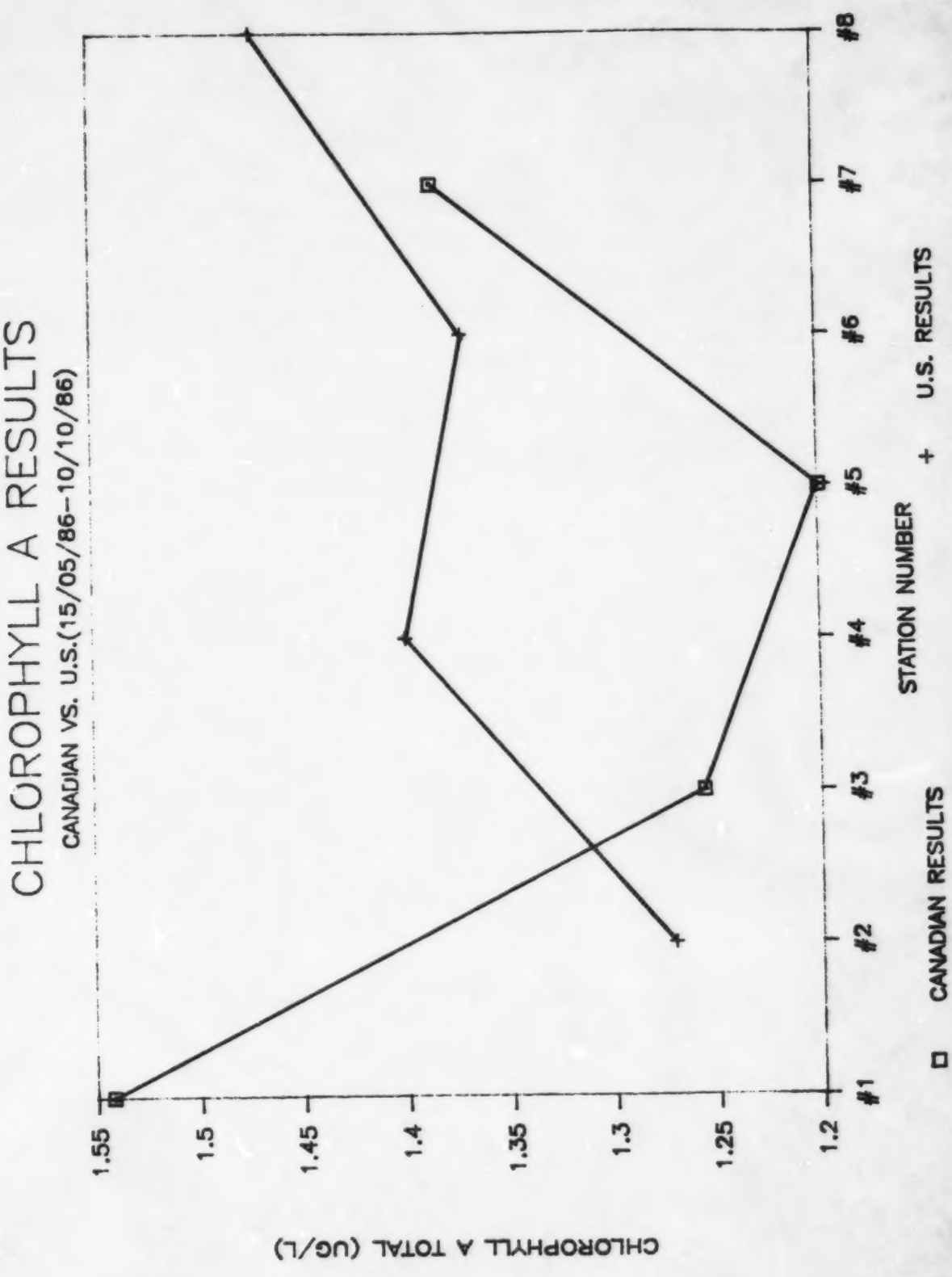


FIGURE 18:

ST. CLAIR RIVER

CHLOROPHYLL a STATIONS 1986

FIGURE 19: CHLOROPHYLL A RESULTS: ST. CLAIR RIVER 1986



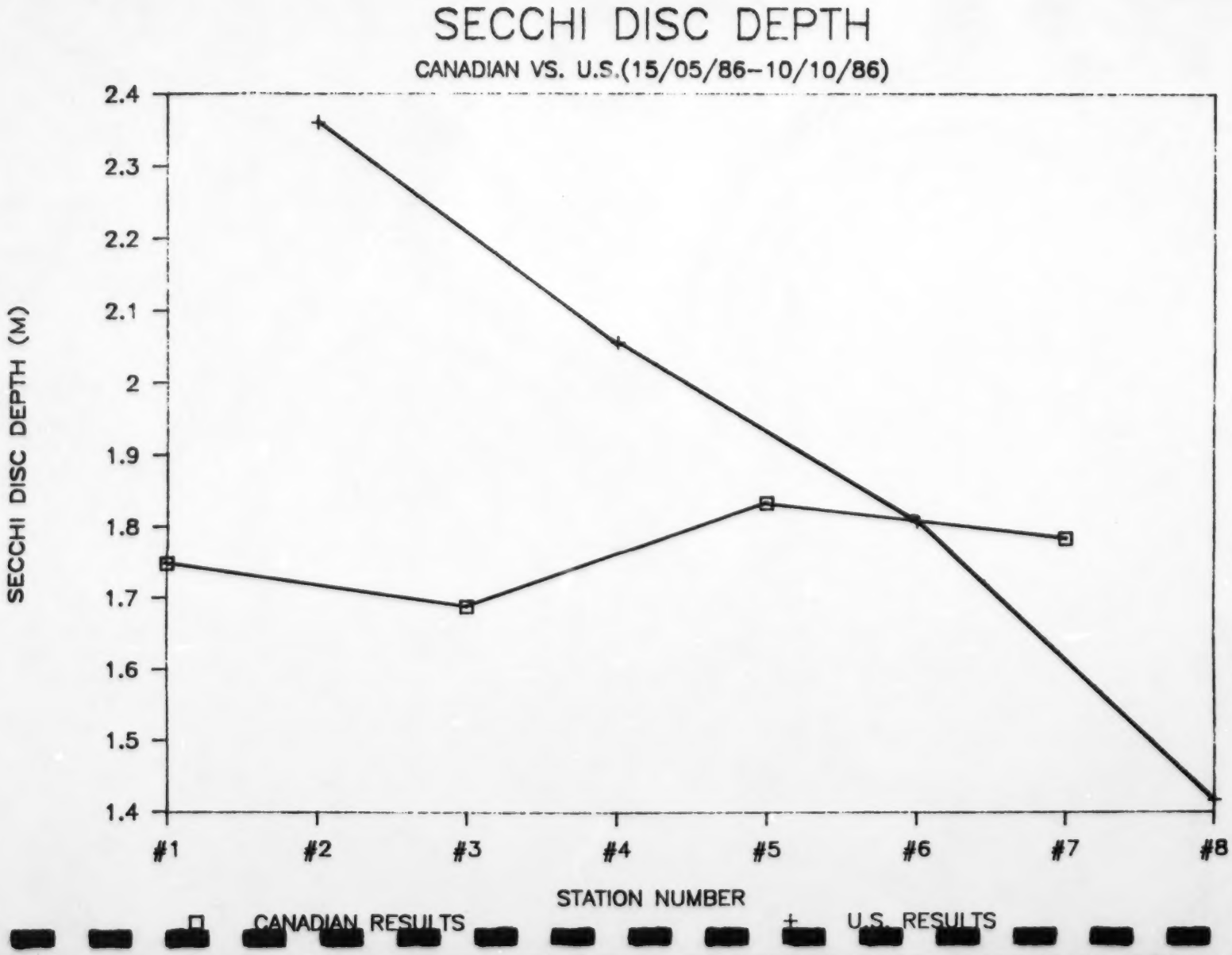


FIGURE 20. SECCHI DISC DEPTH: ST. CLAIR RIVER 1986

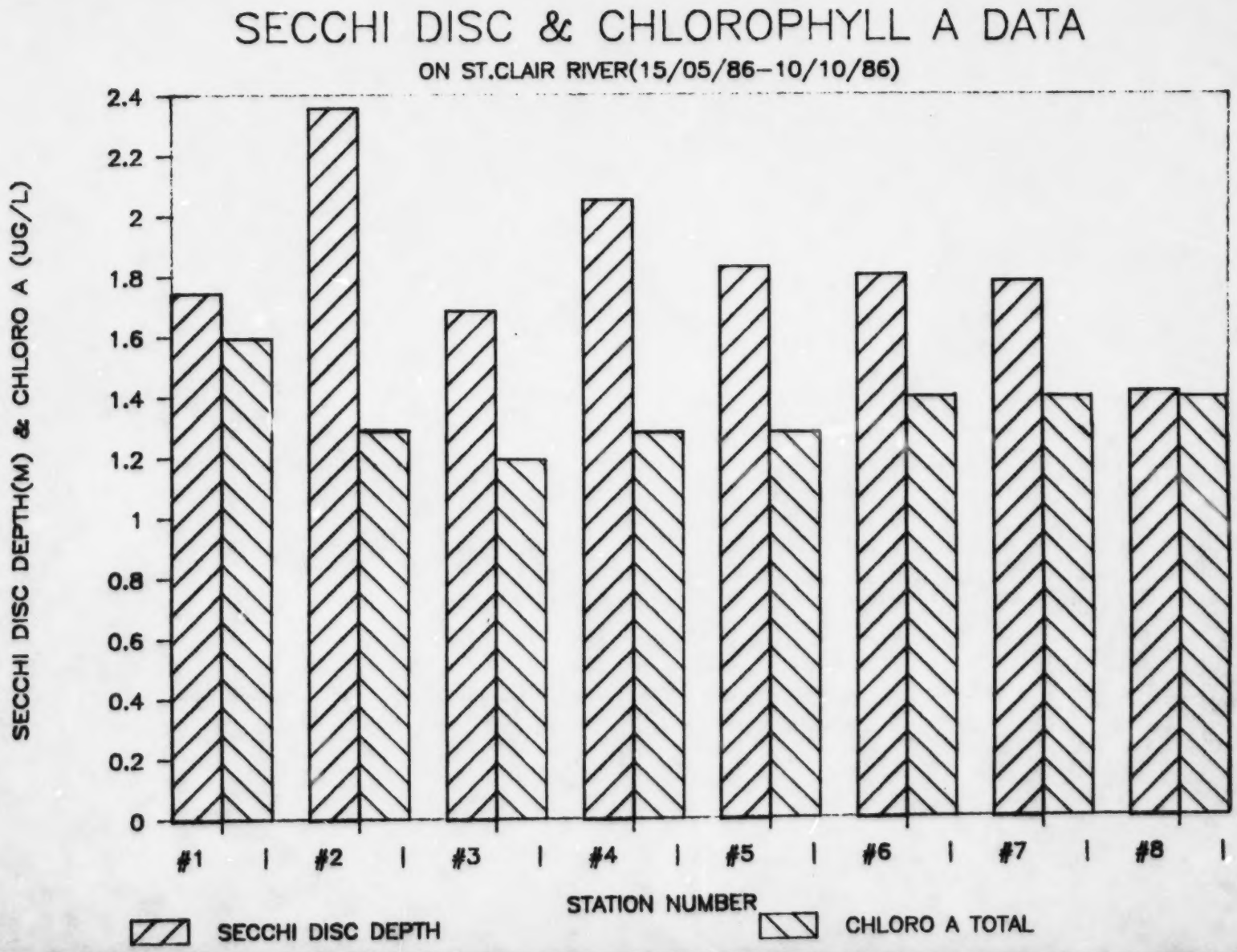


FIGURE 11. SUMMARY OF SECCHI DISC AND CHLOROPHYLL A DATA: ST. CLAIR RIVER 1986

PHYTOPLANKTON

Contaminant Monitoring:

Large volume (68 litre) water samples obtained July 30th, 1986 at stations 202, 204 and 18 (10m offshore) were size fractionated into >20 and <20 um fractions (c/o M. Munawar - Great Lakes Laboratory for Fisheries and Aquatic Science, Burlington, Ontario) through filtration. Subsequent analysis of these total seston fractions for PCB/OC pesticides and other trace organics (c/o B. Oliver - National Water Research Institute, Burlington) provided the following results:

Contaminants in Seston:

PARAMETER (ng/g)	STATION					
	202		204		18	
	<20um	>20um	<20um	>20um	<20um	>20um
1,4-Dichlorobenzene	38	-	1600	500	420	-
1,2-Dichlorobenzene	-	-	-	210	81	-
Hexachloroethane	0.9	21	120	57	12	22
1,2,4-Trichlorobenzene	22	27	120	28	37	27
Hexachlorobutadiene	-	72	670	550	200	360
Pentachlorobenzene	6.5	-	81	62	35	47
Hexachlorobenzene	6.4	53	1400	2700	420	1300
α-BHC	7.5	12	18	3.4	12	2
Octachlorostyrene	7.2	18	820	1100	290	610
PCB Total	340	460	3000	800	1100	640
DDT	7.5	-	3.9	4.6	13	13
DDD	-	-	-	-	27	22
DDE	17	28	75	15	31	29

HETEROTROPHIC BACTERIA

Samples of bottom water and sediment were collected from the 11 ecosystem stations (figure 16) on August 26, 1986 for the enumeration of heterotrophic bacteria.

A literature review is presently underway to assist in evaluation of results. With the exception of the head and mouth transects, all stations lie along the Canadian shoreline.

Bottom waters and sediment at the head of the river contained higher numbers of heterotrophic bacteria on the Canadian side of the river, compared to the American side.

Water

Heterotroph counts from bottom waters along the Canadian shore increased from 2200 organisms/mL at the head of the St. Clair River to 10,500 at the mouth. A maximum of 17,500 was recorded at the mouth of Talford Creek.

Bottom waters along the American shore revealed increased bacterial densities from 110 organisms/mL at the head of the river to 13,000 organisms/mL at the mouth.

Sediment

Bottom sediment bacteria increased from a density of 1500 bacteria/mL at the head of the river on the Canadian shore to 450,000 at the river mouth. A maximum of 500,000 heterotrophs/mL was recorded downstream of Dow Chemical.

Along the American shoreline, bacterial densities increased from 700 heterotrophs/mL at the head of the river to 27,000 heterotrophs/mL at the mouth.

INVESTIGATIVE SAMPLING

Water Sampling

Three investigative runs at 43 stations (figure 22) were completed during 1986; May 26-29, July 14-17 and October 20-24. Results have been received and are discussed for the May and July surveys.

Chlorinated Organics

Only three chlorinated organic compounds were detected in May (Table 10). Hexachloroethane (HCE) was detected at 17 sites ranging from 10 ng/L to a maximum of 169 ng/L immediately downstream from the Cole Drain. All other detectable results were confined to stations adjacent to Dow and Suncor along the Canadian shore.

Hexachlorobutadiene (HCBD) was also measured at 17 sites, in an more confined area, limited to Canadian waters offshore from Dow. Concentrations ranged from 10 ng/L to 87 ng/L with the higher concentrations found generally in bottom waters. Hexachlorobutadiene has a non-toxic effect level of 3000 ng/L for protection of aquatic life.

Hexachlorobenzene (HCB) was detected at 5 sites offshore from Dow ranging in concentration from 10 ng/L to 75 ng/L. Again bottom waters contained the highest concentration. There is an interim Provincial water Quality Objective (PWQO) of 6.5 ng/L for HCB.

Hexachlorobenzene and hexachlorobutadiene were detected in July samples. Octachlorostyrene (OCS) was detected for the first time in July; however, hexachloroethane was not detected during this cruise.

Hexachlorobenzene was detected downstream of the Cole Drain and offshore from Dow. Concentrations ranged from 15 ng/L to a maximum of 210 ng/L in a surface water sample obtained offshore from the Dow Second Street sewer.

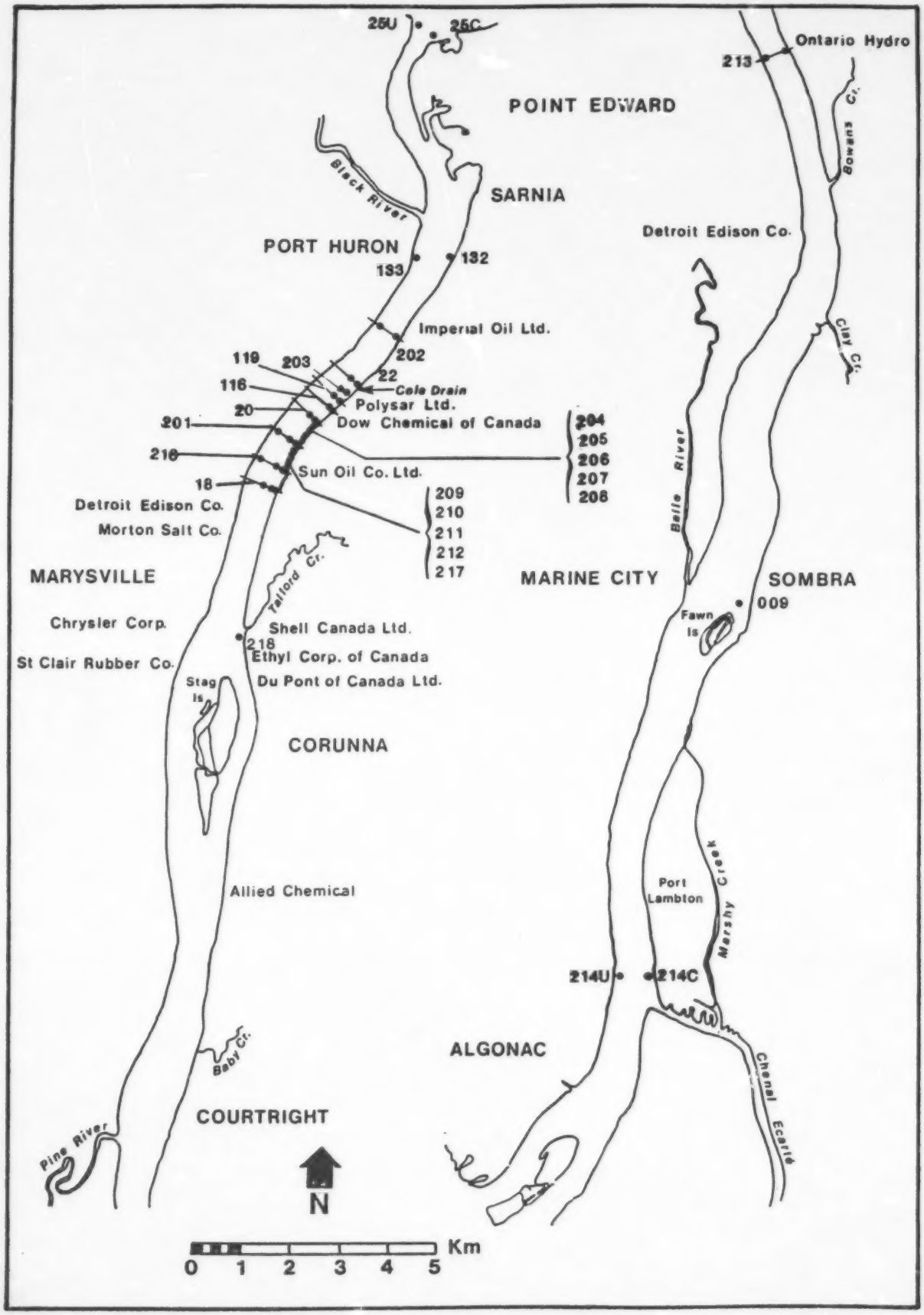


FIGURE 22: Investigative sampling locations

TABLE 10: ST. CLAIR RIVER MISA INVESTIGATIVE COMPONENT MAY 26-29, 1986

CHLORINATED ORGANICS:

RIVER STATION	HCE ng/l		HCBD ng/l		2,4,5-Trichloro toluene ng/l		HCB ng/l		OCS ng/l	
	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.
25 Can	3<T	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
25 US	1<W	4<T	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
132	1<W	1<T	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
133	1<W	5<T	1<W	3<W	5<W	5<W	1<W	1<W	1<W	1<W
202 Can	1<W	1<T	1<W	1<W	6<W	5<W	1<W	1<W	1<W	1<W
202 US	4<T	1<T	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
22 30 m	1<W	1<W	1<W	3<W	5<W	5<W	1<W	1<W	1<W	1<W
22 100 m	1<W	8<T	1<W	2<W	5<W	5<W	1<W	1<W	1<W	1<W
22 200 m										
203	1<W	1<W	1<W	5<W	5<W	5<W	1<W	7<W	1<W	1<W
119 30 m	1<W	169	1<W	87	5<W	10<T	1<W	5<W	1<W	1<W
119 100 m	1<W	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
116 10 m	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
116 30 m	1<W	NR	1<W	NR	5<W	NR	1<W	NR	1<W	NR
20 10 m	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
20 30 m	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
20 100 m	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
204	50	49	44	44	10<T	10<T	12	12	1<W	1<W
205	12	1<W	7<T	27	10<T	5<W	1<W	3<T	1<W	1<W
206	1<W	11	1<W	11	5<W	5<W	1<W	4<W	1<W	1<W
207	7<T	7<T	4<T	57<T	5<W	5<W	1<W	75	1<W	1<W
208	1<W	10	3<T	57<T	5<W	5<W	4<T	10	1<W	1<W
201 10 m	20	8<T	12	1<W	5<W	5<W	1<W	1<W	1<W	1<W
201 30 m	20	8<T	20	27	5<W	5<W	4<T	6<T	1<W	1<W
201 100 m	1<W	3<T	1<W	60	5<W	5<W	1<W	1<W	1<W	1<W
201 533 m	2<T	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
209	1<W	16	1<W	22	5<W	5<W	3<T	12<T	1<W	1<W
210	1<W	1<W	1<W	4<W	5<W	5<W	1<W	3<T	1<W	1<W
211	1<T	2<T	3<T	1<W	5<W	5<W	7<T	2<T	1<W	1<W
212	3<T	8<T	2<T	7<W	5<W	5<W	1<T	2<T	1<W	1<W
217	12	9<T	4<T	8<T	5<W	5<W	1<W	1<W	1<W	1<W
216 10 m	19	14	10	7<T	5<W	5<W	1<W	10T	1<W	1<W
216 30 m	10	1<W	11	1<W	5<W	5<W	1<W	1<W	1<W	1<W
216 100 m	1<W	2<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
216 533 m	1<W	6<T	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
18 10 m	10	10	6<T	9<T	5<W	5<W	1<W	1<W	1<W	1<W
18 30 m	3<T	5<T	7<T	8<T	5<W	5<W	1<W	5<T	1<W	1<W
18 100 m	1<W	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
218	1<W	3<T	1<W	6<T	5<W	5<W	1<W	1<W	1<W	1<W
213 100 m	1<W	1<W	1<W	1<W	5<W	5<W	1<W	2<T	1<W	1<W
213 500 m	1<W	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
009	1<W	1<W	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
214 120 m	1<W	1<W	1<W	1<T	5<W	5<W	1<W	1<W	1<W	1<W
214 550 m	1<W	3<T	1<W	1<W	5<W	5<W	1<W	1<W	1<W	1<W
Blank/Rep:										
203 Rep	4<T	1<W	1<W	1<T	5<W	5<W	1<W	1<W	1<W	1<W
203 Blank	1<W	-	1<T	-	5<W	-	1<W	-	1<W	-
20 Rep (10 m)	9<T	1<W	8<T	11	5<W	5<W	1<W	1<W	1<W	1<W
209 Rep	13	2<T	10	45	5<W	5<W	6<T	5<T	1<W	1<W
209 Blank	1<T	-	1<W	-	5<W	-	1<W	-	1<W	-
217 Rep	8	7<T	12	1<W	5<W	5<W	1<W	1<W	1<W	<W
217 Blank	1<W	-	1<W	-	5<W	-	1<W	-	1<W	-

<T Tentative Value
<W Value is Less Than Minimum Measurable Amount
NR Sample Not Received

Hexachlorobutadiene (HCBD) was detected at 29 of the 43 stations in July whereas HCBD was detected only offshore from Dow in May. Levels above 1 ng/L were observed as far downstream as the Lambton Generating Station in July. Concentrations ranged from 1 ng/L to 55 ng/L offshore from the Dow First Street sewers. With the exception of a sample offshore from the First Street sewers, bottom waters contained higher concentrations of HCBD.

As previously indicated, octachlorostyrene was not observed in May but was detected in 7 samples in July. A concentration of 17 ng/L was measured in bottom waters downstream from the Cole Drain. A maximum concentration of 20 ng/L was detected at the Dow Second Street sewer.

Results from the third investigative run are not yet available.

Volatiles

Seven volatile compounds were detected during the first investigative sampling (Table 11).

Tetrachloroethylene was the most widely detected volatile compound found in 33 samples. Its distribution was restricted to offshore from Dow and Suncor. The highest concentration of 44 ug/L was detected at 30 m offshore from the Dow First Street sewers. There is no Provincial Water Quality Objective in terms of aquatic life for tetrachloroethylene. Concentrations were generally less than the Word Health Organization (WHO) tentative drinking water guideline (10 ug/L).

Trichloroethylene and 1,1,2-trichloroethane were detected offshore from Dow at concentrations less than limits for drinking water and the protection of aquatic life. The significance of 1,1,1-trichloroethane and 1,1-dichloroethane detected offshore from Dow is not known.

Thirteen samples contained 1,2-dichloroethane; two of which (11 and 16 ug/L) exceeded a WHO drinking water guideline (10 ug/L).

TABLE 11: ST. CLAIR RIVER MISA INVESTIGATIVE COMPONENT MAY 26-29, 1986

VOLATILES:

RIVER STATION	1,1-Dichloro-ethane (ug/l)		1,1,1-Trichloro ethane (ug/l)		1,3-Dichloro-ethane (ug/l)		CCl (ug/l)		Trichloro-ethylene (ug/l)		1,1,2-Trichloro ethane (ug/l)		Tetrachloro-ethylene (ug/l)	
	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.	Surf.	Bott.
25 Can	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25 US	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
132	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
133	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
202 Can	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
202 US	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22 200 m														
203	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
119 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
119 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
116 10 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
116 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20 10 m	7	ND	10	ND	11	ND	ND	ND	1	ND	2	ND	3	ND
20 30 m	ND	ND	4	2	1	ND	ND	42	ND	ND	ND	ND	ND	44
20 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1
204	13	ND	18	ND	12	ND	ND	ND	1	ND	3	ND	4	2
205	ND	ND	2	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
206	3	ND	5	ND	ND	ND	1	ND	ND	ND	ND	ND	3	2
207	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND
208	ND	ND	2	ND	2	ND	ND	ND	ND	ND	ND	ND	2	1
201 10 m	ND	ND	2	ND	1	ND	ND	ND	ND	ND	ND	ND	2	ND
201 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1
201 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
201 533 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
209	4	2	5	2	3	2	ND	ND	ND	ND	ND	ND	3	1
210	ND	1	ND	2	ND	1	ND	ND	ND	ND	ND	ND	ND	1
211	ND	ND	2	ND	1	ND	ND	ND	ND	ND	ND	ND	2	1
212	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
217	ND	ND	1	1	ND	ND	ND	ND	ND	ND	ND	ND	4	3
216 10 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	3
216 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	3
216 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
216 533 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18 10 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	2
18 30 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	1
18 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
218	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
213 100 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
213 600 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
214 120 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
214 550 m	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Blanks/Replicates														
203 Rep	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
203 Blank	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-
20 Rep	14	ND	22	ND	16	ND	4	ND	2	ND	4	ND	10	1
20 Blank	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-
209 Rep	9	2	9	2	5	1	3	ND	1	ND	1	ND	7	1
209 Blank	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-
217 Rep	ND	ND	1	1	ND	ND	5	5	ND	ND	ND	ND	4	4
217 Blank	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-	ND	-

ND Not detected
- Not Measured

Carbon tetrachloride was detected offshore from Dow at concentrations ranging from 1 ug/L to a maximum of 42 ug/L, the latter well in excess of the WHO drinking water criterion (3 ug/L) and a US EPA guideline (6.9 ug/L) for the protection of fish for human consumption.

Eight volatile contaminants were detected during the second investigative sampling. Again, tetrachloroethylene was the most common compound detected and was found in 43 samples. Although detected primarily near Dow it was found as far downstream as the Lambton Generating Station. A maximum concentration of 22 ug/L was detected in a bottom water sample 30 meters offshore from the Dow First Street sewers.

Carbon tetrachloride was detected in 41 samples ranging from 1 ug/L to 8 ug/L. It was found farther downstream than in May, extending downstream to the Lambton Generating Station at Courtright.

Chloroform was detected for the first time near the Cole drain and near Dow.

Surficial Sediment Sampling

Appendix 6 provides a listing of data currently available from surficial (top 3 cm) sediment grabs on the St. Clair River. At present, only metals, nutrients and particle size analyses are complete. Sampling was concentrated in the area from the Dow 1st. St. complex to the southern Suncor boundary at a subset of investigative (figure 22) sampling locations.

A trend of decreasing concentrations with increasing distances from shore is evident for metals at station 20. Cadmium, chromium, copper, mercury, magnesium and nickel are 2-9 times higher in the nearshore (10 m offshore) station vs. the station 30 m offshore.

Comparison of mercury concentrations measured during the 1985 MOE/Environment Canada investigation are generally in agreement with the present study. Mercury levels of 28 ug/g were observed in surficial sediments adjacent to Dow property during 1985. Corresponding MISA data reveals mercury in the range of 1 to 42 ug/g. Low but consistent mercury (≈ 5 gram/day) loadings have been measured from the Dow 54" sewer during 1986 twice weekly effluent sampling.

Results from an additional 13 stations (202, 20 (100 m), 201 (10, 30, 100, 533 m off), 216 (10, 30, 100, 533 m off), 18 (10, 30, 100 m off) and 213 (100 and 500 m off)) are currently being analysed.